

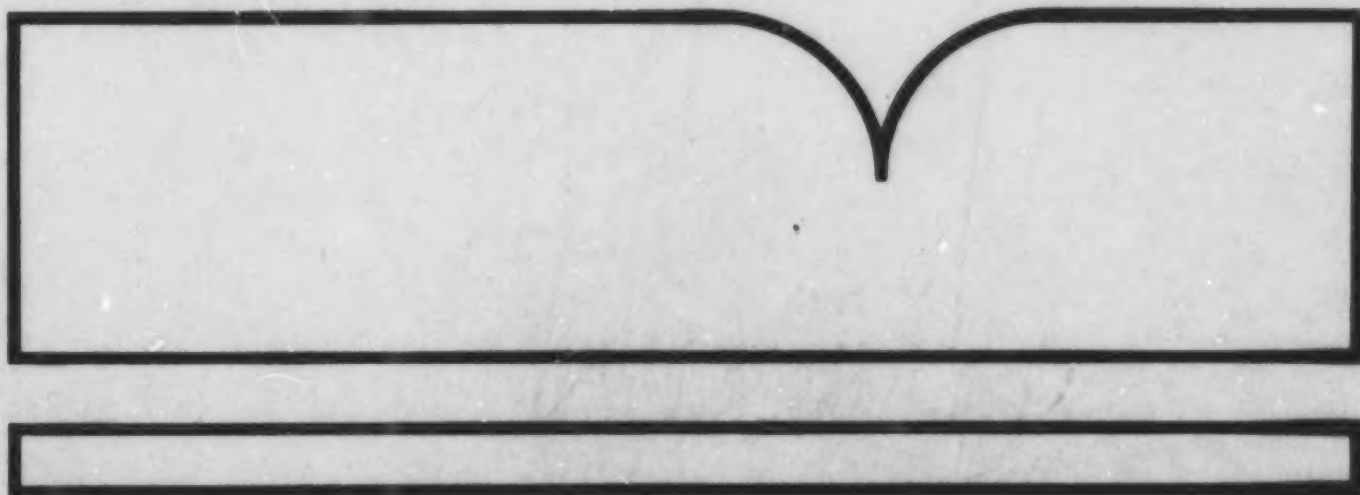
Livestock and the Environment
A Bibliography with Abstracts. Volume VII

East Central Carolina State Univ., Ada

Prepared for

Robert S. Kerr Environmental Research Lab.
Ada, OK

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LIVESTOCK AND THE ENVIRONMENT

A Bibliography with Abstracts

Volume VII

by

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Linda Merryman

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School of Environmental Science

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OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
ADA, OKLAHOMA 74820**

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16. ABSTRACT Management and research information on animal wastes has expanded in recent years. This material has appeared in such diverse sources as journal articles, conference papers, university publications, government publications, magazine articles, books or book chapters, and theses. This bibliography was compiled in order to speed the flow of information on findings in one segment of livestock industry to other segments that could benefit from this technology.		
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FOREWORD

EPA is charged by Congress to protect the Nation's land, air and water systems. Under a mandate of national environmental laws focused on air and water quality, solid waste management and the control of toxic substances, pesticides, noise, and radiation, the Agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life. In partial response to these mandates, the Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma, is charged with the mission to manage research programs to investigate the nature, transport, fate, and management of pollutants in groundwater and to develop and demonstrate technologies for treating wastewaters with soils and other natural systems; for controlling pollution from irrigated crop and animal production agricultural activities; for controlling pollution from petroleum refining and petrochemical industries; and for managing pollution resulting from combinations of industrial/industrial and industrial/municipal wastewaters.

This project was initiated in 1970 to facilitate the dissemination and technological transfer of information on the management and disposal of animal wastes throughout the livestock industry. Seven periodic bibliographies containing abstracts of over 5,000 articles concerned with livestock wastes management and control of related environmental pollution were prepared and published during the decade that this project was supported. This volume represents the final output of this effort.

Clinton W. Hall

Clinton W. Hall

Director

Robert S. Kerr Environmental
Research Laboratory

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ABSTRACT

Management and research information on animal wastes has expanded in recent years. This material has appeared in such diverse sources as journal articles, conference papers, university publications, government publications, magazine articles, books and book chapters, and theses. This bibliography was compiled in order to speed the flow of information on findings in one segment of the livestock industry to other segments that could benefit from this technology.

Included in this publication are the following indexes: (1) author, (2) animal information categories, and (3) keyword index. These indexes are followed by a section of abstracts of each reference entry found in the bibliography. Single copies of most articles can be obtained in hard copy or microfiche form at cost from the Animal Waste Technical Information Center, East Central Oklahoma State University, Ada, Oklahoma 74820.

This report was submitted in fulfillment of Grant Number R-805151-02 by the School of Environmental Science, East Central Oklahoma State University, Ada, Oklahoma, under the sponsorship of the U. S. Environmental Protection Agency. This report covers the period March 1, 1979, to February 28, 1980, and work was completed as of June 30, 1980.

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ACKNOWLEDGEMENTS

This bibliography was prepared under the auspices of the School of Environmental Science, East Central Oklahoma State University, under U.S. Environmental Protection Agency Grant Number R-805151-02. M. L. Rowe, the principal investigator, was assisted by Linda Merryman and Darla Stettler in the compilation of this bibliography. Student personnel deserving special mention for their contributions to this effort are: Myrna Stiles and Kathy Little.

The project staff extends its gratitude to the authors and publishers for use of their publications in these bibliographic entries. Work contributed by Laurin Patton, Assistant Professor of the School of Environmental Science at East Central Oklahoma State University, is deeply appreciated. Special thanks is also extended to EPA Project Officer R. Douglas Kreis for his assistance in the preparation of this bibliography.

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SECTION I

INTRODUCTION

Evolving regulations and aims pertaining to pollution abatement and control have necessitated a timely and well-dispersed flow of pertinent information concerning animal waste management so that capital investments in the animal production industry can be made on the basis of the most recent research and operational findings. In many activities, industrial and manufacturing organizations or associations provide the linkage channels through which such information may flow. The wide range in operation sizes and makeup, the geographic factors, and the dictates of the local or regional markets make widespread dissemination of animal waste management information difficult even through the established communication networks such as breed associations, farm organizations, and the popular agricultural press. Common properties and characteristics of animal wastes enable technological transfers to occur in the production operations from one species to another. Publicizing practices of findings in one segment of the livestock production industry can spread new ideas and techniques to other segments of the industry.

The objective of this project is to facilitate the dissemination and technological transfer of information on the management and disposal of animal wastes throughout the livestock industry. Identification and location of pertinent information generated in the production operations of poultry, swine, cattle, fish, and other animals of economic interest raised in open or confined systems is accomplished through searches of technical journals, books, theses, reports from private, state and federal agencies, papers given at meetings of professional societies or symposiums, and articles appearing in the trade or production-oriented "farm" magazines.

The search topics of specific interest include: (1) The environmental impact of animal production activities on water, groundwater, air, soil systems, health, and aesthetics. (2) Feedlot, confinement pen, rangeland, and pasture land management, including animal waste management; the use of chemical fertilizers, manures, green manures, and sewage sludge in conjunction with animal production areas or animal production-related areas; and pollution effects of crop residues, soil losses and sediments production from animal production areas to animal production-related areas. (3) Legal, economic, and social constraints. (4) Research and development. The project staff will maintain a file copy of all articles which appear in the bibliography. Upon request to the project staff, users will be supplied a copy of individual articles at cost provided that copyright permission has been obtained.

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An updated bibliography of animal waste management information is prepared annually. It contains entries and abstracts for all new items maintained in the collection at the Animal Waste Technical Information Center.

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It is anticipated that users of this bibliography will secure pertinent publications from local libraries or through interlibrary loan. However, single copies of most publications (those for which copying approval has been obtained from copyright owners) may also be obtained upon request in hard copy or microfiche form at a cost-only fee from the following address:

Mrs. Darla Stettler, Assistant Librarian
Animal Waste Technical Information Center
School of Environmental Science
East Central Oklahoma State University
Ada, Oklahoma 74820

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SECTION 2

USER'S GUIDE

The entries in this bibliography have been assigned a specific cross reference code. The code number consists of nine digits (example: 300-74-4453) arranged in the sequences of a three-digit class code, a two-digit number representing the year of publication or presentation, and a four-digit accession number identifying each article brought into the animal waste information collection. The first grouping identifies the class code of the document according to the following format:

Code	Class
100	Technical journal paper
200	Conference proceeding paper
300	University or government publication
400	Magazine article
500	Book or chapter from a book
600	Unpublished paper
700	Thesis

This publication consists of five sections: Author Index, Animal Information Category Index, Keyword Index, and Abstracts. An explanation of each section follows.

AUTHOR INDEX

This index lists all the authors cited in the bibliography in alphabetical order. To the right of each author entry is the cross reference code of the article or articles with which he is identified. An example of the format is as follows:

ABE R K	200 77 5351
ABELES T	300 78 5766
ADAMS A	100 76 5511
ADOLPH R	400 71 5826
AGLIRA T	300 71 5545

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ANIMAL INFORMATION CATEGORY INDEX

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To provide a quick entry into the abstract holdings of the collection, an animal information code was developed. This code utilizes an alphabetical entry to signify a broad interest area and a numerical digit to designate a more specific topic under the broad interest area. Each abstract in the collection is classified according to this code and could be listed under the most relevant categories. This provides the user with an easy entry into the abstract holdings pertaining to his information needs. An outline of the categories of information may be found on the next page.

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CATEGORIES OF ANIMAL INFORMATION.

Interest Area

A. Environmental Effects

B. Management of Animal Production and Related Operations

C. Characteristics of Animal Wastes

D. Treatment Processes

E. Utilization and Disposal

F. General

Topic Area

1. General
2. Surface Runoff from Animal Production
3. Surface Runoff from Agricultural Watersheds
4. Surface Water Pollution
5. Groundwater Pollution
6. Odor
7. Air
8. Soil Systems
9. Biocides
10. Vectors
11. Animal Health
12. Public Health
13. Aesthetics

1. General
2. Liquid Systems
3. Solid Systems
4. Storage
5. Pasture Land and Cropland Management

1. Physical
2. Chemical
3. Biological

1. Physical
2. Chemical
3. Biological

1. General
2. Land Disposal or Reuse
3. Recycling
4. By-Product Recovery

1. Economics
2. Legalities
3. Policy Needs
4. Overviews

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The entries in the Animal Information Category Index appear by accession number under the code number as found in the following example.

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KEYWORD INDEX

The index consists of an alphabetical listing of significant words in an article or in the title of an article. To the right of the keyword are the first 85 characters contained in the title or the title and a listing of keywords, if the title is short. To the left of the keyword is the nine digit cross reference code of the article ascribed to by the keyword. The cross reference code allows the user to look up the abstract for additional information about the title. An example of this index format is:

100 79 5812	AERATION	FLOCCULATION OF ANIMAL SLURRIES
100 79 5870	AERATION	RUNOFF CONTROL COMPARISONS FOR
300 79 5908	AERATION	ODOR CONTROL CHEMICALS FAIL ILLINOIS
200 77 5347	AEROBIC	THERMOPHILIC AEROBIC DIGESTION OF
400 75 5392	AEROBIC	WASTE TREATMENT-WHERE DOES IT FIT IN

ABSTRACTS

This section contains the abstracts of the information entries contained in the bibliography. Each entry includes the title of the informational material, the author or authors, the bibliographic citation, keywords, and the abstract. The abstracts are arranged sequentially by an assigned accession number which specifically identifies the article in the collection. To the right of the accession number are the animal information category code numbers assigned to the abstract entry.

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SECTION 3

AUTHOR INDEX

This index lists all the authors cited in the bibliography in alphabetical order. To the right of each author entry is the cross reference code of the article or articles with which he is identified. Please refer to "Section 2: User's Guide" for examples.

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AUTHOR INDEX

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ABELES T P	300 78 5766	BRUCE B B	300 79 5599		100 78 5483
	300 78 5767	BRUGGER M F	400 78 5513		300 78 5554
	300 78 5768		400 78 5581		300 77 5725
ADAMS A W	100 76 5511		400 79 5644		400 78 5785
ADOLPH R H	400 71 5826	BRUMM M C	100 79 5708		300 79 5893
AG DVLPMNT ADV SERV	300 76 5639		100 79 5807		300 76 5874
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AINES C E	300 79 5805	BUCK H	300 78 5559	DONKER J D	100 64 5677
ALBERT M H	300 77 5859		200 78 5682	DORLING T A	100 73 5896
ALBRIGHT L D	200 78 5433	BURNS E R	300 78 5873	DOYLE R C	100 78 5673
ALDERSON N B	100 79 5816	BURROUGHS W	300 76 3708	DRAPER D W	200 79 5452
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ALEXANDER F	100 77 5721	BUTCHER J E	200 75 5641	DUNCOMB D R	200 77 5329
ALLEN J B	300 75 5551		200 74 5750	EDWARDS R	400 79 5647
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ASHFIELD G	400 78 5539		100 78 5887	FEHR R L	200 77 5333
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ATKINSON C W	200 77 5332	CHIA S P	100 78 5862	FINNIE J D	200 72 5894
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AUSTIC R E	100 78 5592	CHRISTENSEN K D	100 74 5779		200 78 5397
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Interest Area

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A. Environmental Effects

1. General
2. Surface Runoff from Animal Production
3. Surface Runoff from Agricultural Watersheds
4. Surface Water Pollution
5. Groundwater Pollution
6. Odor
7. Air
8. Soil Systems
9. Biocides
10. Vectors
11. Animal Health
12. Public Health
13. Aesthetics

B. Management of Animal Production

1. General
2. Liquid Systems
3. Solid Systems
4. Storage
5. Pasture Land and Cropland Management

C. Characteristics of Animal Wastes

1. Physical
2. Chemical
3. Biological

D. Treatment Processes

1. Physical
2. Chemical
3. Biological

E. Utilization and Disposal

1. General
2. Land Disposal or Reuse
3. Recycling
4. By-Product Recovery

F. General

1. Economics
2. Legalities
3. Policy Needs
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5782	5517	5757	5506	5814	5350
5790	5517	5758	5508	5815	5356
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5388	5680	5367	5758	5653	5411
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C1	C1	C2	C2	C3	C4
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5892	5505	5711	5914		
	5508	5718			

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5634	5857	5585	5462
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SECTION 5

KEYWORD INDEX

This is the keyword index for the abstracts found in this volume. This index consists of an alphabetical listing of significant words in an article or in the title of an article. To the right of the keyword are the first 85 characters contained in the title or the title and a listing of keywords, if the title is short. To the left of the keyword is the nine digit cross reference code of the article ascribed to the keyword. The cross reference code allows the user to look up the abstract for additional information about the title. Please refer to "Section 2: User's Guide" for examples.

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KEYWORD INDEX

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100 78 5729 ABANDONED-FEEDLOTS CROPPING AN ABANDONED FEEDLOT TO PREVENT DEEP PERCOLATION OF NITRATE-NITROGEN KEYWORDS
100 78 5816 ABSORPTION OXYTETRACYCLINE ABSORPTION AND EXCRETION IN METHERS KEYWORDS OXYTETRACYCLINE SHEEP EXC
100 78 5844 ABSORPTION SAFE DISPOSAL OF PIGGERY EFFLUENT ASSISTS EROSION CONTROL KEYWORDS ECONOMICS WASTE-DIS
100 78 5527 ACETATE CHANGES IN PROPORTIONS OF ACETATE AND CARBON DIOXIDE USED AS METHANE PRECURSORS DURING
100 77 5877 ACETATE STUDIES INVESTIGATING POSSIBILITIES OF UTILIZING DECANTED SOLIDS FROM PIG FAECES IN THE
300 77 5859 ACETIC-ACID FERMENTATION CHARACTERISTICS AND NUTRITIONAL VALUE OF ENSILED CAGED LAYER WASTE AND COR
300 79 5599 ACIDOPHILUS INFLUENCE OF FEEDING CELLS OF LACTOBACILLUS ACIDOPHILUS ON THE FECAL FLORA OF YOUNG DAI
100 79 5494 ACIDS PROCESSING AND HANDLING OF ANIMAL EXCRETA FOR REFEEDING KEYWORDS REFEEDING LIVESTOCK-W
100 78 5800 ACTINOMYCETES DEODORIZATION OF PIG FECEES BY ACTINOMYCETES KEYWORDS SWINE-WASTES DEODORIZATION ACTIN
100 75 5605 ACTIVATED-SLUDGE CHEMICAL FLOCCULATION AS A TERTIARY TREATMENT FOR PIG EFFLUENT KEYWORDS BIOLOGICAL-TRE
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NUTRITIONAL AND ECONOMIC VALUE OF ANIMAL EXCRETA KEYWORDS ANIMAL-WASTES POULTRY-LITTER PROCESSING AND HANDLING OF ANIMAL EXCRETA FOR REFEEDING KEYWORDS REFEEDING LIVESTOCK-W USE OF ANIMAL EXCRETA FOR MICROBIAL AND INSECT PROTEIN SYNTHESIS KEYWORDS ANIMAL-WASTE ALTERNATIVES IN ANIMAL WASTE UTILIZATION--INTRODUCTORY COMMENTS KEYWORDS ANIMAL-WASTE HUMAN AND ANIMAL HEALTH ASPECTS OF FEEDING LIVESTOCK EXCRETA KEYWORDS ANIMAL-WASTE REGULATORY CONSIDERATIONS IN THE USE OF ANIMAL WASTE AS FEED INGREDIENTS KEYWORDS ANIN HIGH TEMPERATURE DRYING OF ANIMAL WASTE KEYWORDS DEHYDRATION ODOR-CONTROL POULTRY-WAST ORGANOLEPTIC, CHEMICAL AND BACTERIAL CHARACTERISTICS OF MEAT AND OFFALS FROM BEEF CATTLE A LABORATORY EVALUATION OF ORGANIC ACIDS AND FORMALDEHYDE AS PRESERVATIVES FOR WET CAGE THE POTENTIAL HAZARD OF LIVESTOCK WASTE RECYCLING. 1. PERFORMANCE AND CARCASS EVALUATIO CONDITIONING DAIRY COWS TO EAT TAINTED GRASS KEYWORDS CATTLE REFEEDING CATTLE-WASTES P ALGAE OFFERS EFFICIENT WAY TO RECYCLE SWINE WASTES KEYWORDS SWINE-WASTES ANAEROBIC LAG MSU PROCESS TURNS WASTE FILTRATE INTO SUPPLEMENT KEYWORDS FERMENTATION FEEDLOT-WASTES FEED ADDITIVE RESIDUES IN ANIMAL MANURE PROCESSED FOR FEED KEYWORDS FEED-ADDITIVES RE THE ACCUMULATION OF COPPER IN THE LIVER OF LAMBS ON DIETS CONTAINING DRIED POULTRY WAST CHANGES IN SWINE MANURE DURING ANAEROBIC DIGESTION KEYWORDS SWINE-WASTES ANAEROBIC-DIG POULTRY WASTES-NITROGEN FOR COWS KEYWORDS POULTRY-WASTES-DRIED REFEEDING DAIRY-CATTLE MULTISTAGE CONTINUOUS FERMENTATION OF POULTRY MANURE TO A HIGH PROTEIN FEEDSTUFF KEYWOR LAYER MANURE MAKES USABLE FEEDSTUFF, AFFECTS CARCASS KEYWORDS REFEEDING POULTRY-WASTES RECYCLED ANIMAL WASTE AS ANIMAL FEED--RESPONSE TO FOA REQUEST FOR DATA, INFORMATION AND REFEEDING ODM AND DRIED SWINE FECES TO SWINE KEYWORDS LIQUID-WASTES SOLID-WASTES SWIN VALUE OF BROILER LITTER FOR FEEDING BEEF CATTLE KEYWORDS POULTRY-LITTER REFEEDING CATT SILAGE OF MANURE AND FINAL MOLASSES. 2. 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SECTION 6

ABSTRACTS

This section contains the abstracts of the information entries contained in the bibliography. Each entry includes the title of the informational material, the author or authors, the bibliographic citation, keywords, and the abstract. The abstracts are arranged sequentially by an assigned accession number which specifically identifies the article in the collection. To the right of the accession number are the animal information category code numbers assigned to the abstract entry.

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5314-B1

A NOVEL METHOD OF SEPARATING URINE AND FAECES FROM FEMALE PIGS

National Institute for Research in Dairying, Shinfield, Reading, RG2 9AT
A.G. Low
Journal of the Science of Food and Agriculture, V. 28, p. 980-982, 1977. 3 tab., 1 ref.

Keywords: Separation techniques, Swine wastes

A simple stainless steel urine and faeces separator for use with female pigs is described. The equipment fits into a standard Shinfield metabolism cage for pigs. The separator has been used in metabolism trials with pigs from 20 to 90 kg liveweight. (Low-National Institute for Research in Dairying)

5315-A5, B2, B4, C1, C2

DAIRY LAGOON EFFECTS ON GROUNDWATER QUALITY

Assistant Dean, Agricultural Experiment Station, University of Tennessee, Knoxville, Tennessee
J.I. Sewell
Transactions of the ASAE, V. 21, No. 5, p. 948-952, Sept.-Oct., 1978. 5 fig., 4 tab., 7 ref.

Keywords: Dairy wastes, Lagoons, Anaerobic, Flushing, Wastewater reuse, Groundwater pollution, Nitrates, Chloride, Waste composition

At the West Tennessee Experiment Station, an anaerobic lagoon system was put into operation in May 1974; the approximate loading has been 72.5 mg volatile solids/day. Water from the holding pond has been recycled for flushing the dairy lots since January 1975. Seven test wells with mean depths of 3.4 m were installed near the system for obtaining water quality samples. Water-quality parameters for samples from the wells were evaluated for six months before loading the lagoon system and two and one-half years afterward. Nitrate-nitrogen and chloride concentrations in groundwater near the lagoon rapidly increased during the six months immediately following system loading. Probably because of the development of effective seals in the floors of the lagoon and holding pond, $\text{NO}_3\text{-N}$ later tended to decrease to levels near those of the period prior to system loading. Median $\text{NO}_3\text{-N}$ concentrations were associated with high liquid levels in the holding pond. After three years, the primary lagoon has an approximate floating crust depth of 23 cm and a sludge accumulation of 10 cm. The holding pond has a total solids concentration of 2550 mg/L, pH of 7.2, COD of 765 mg/L, $\text{NO}_3\text{-N}$ concentration of 75 mg/L and electrical conductivity of 4,500 micro-mhos/cm. During two years of recycling, chloride concentrations and electrical conductivity have increased markedly while total dissolved solids and $\text{NO}_3\text{-N}$ have increased at a somewhat lesser rate. Recycling lagoon water for flushing has not caused noticeable adverse effects on livestock health or milk quality. (Sewell-University of Tennessee)

5316-B2, E2

DESIGN AND PERFORMANCE OF A LIQUID MANURE INJECTOR

Agricultural Engineering Department, MacDonald Campus, McGill University, Ste. Anne De Bellevue, PQ, Canada
S.C. Negi, E. McKyes, R.J. Godwin, and J.R. Ogilvie
Transactions of the ASAE, V. 21, No. 5, p. 963-966, 971, Sept.-Oct., 1978. 10 fig., 5 ref.

Keywords: Equipment-soil injectors, Design, Soil injection, Land application, Slurries

Field test results from a prototype model of an injection tool were demonstrated to verify force requirements, slurry distribution and cover performance of this device. Study results indicated that: (1) A wide injector operating at a shallow depth is essential for obtaining a given disturbed soil volume with minimum draft force and for meeting the agronomic requirements for aerobic decomposition and nutrient dispersion in the root zone. (2) A narrow rigid shank rigidly mounted, and a wide flat-topped injection tool with a constant approach angle are advantageous for accurate depth control and for consistent soil loosening and waste-covering characteristics. (3) Good agreement was found between the theoretical results and experimental data on injector draft requirements under field conditions. A tractor of 60 to 80 kw power would be sufficient to operate the injector in the vast majority of agricultural soils, although more power might be required to pull additional large liquid tank wagons. (4) The prototype injector performed an effective loosening operation and provided adequate new space under the soil surface to incorporate and cover the liquid injected. (5) Comparison between calculated and measured values of slurry-soil depth for different application rates indicated that the slurry was incorporated into some of the original soil voids and as many of the newly-created pores as necessary. (6) The depth of slurry-soil mix was independent of the depth of injection in a uniform soil. Therefore, the depth of cover increased in linear proportion with the depth of application. (Merryman-East Central)

5317-B2, C1, D1

PERFORMANCE CHARACTERISTICS OF MANURE SLURRY PUMPS

Assistant Dean of Engineering, Nova Scotia Technical College, Halifax, Nova Scotia, Canada
W.M. Carson, W.M. Miller, and F.R. Hore
Transactions of the ASAE, V. 21, No. 5, p. 972-976, Sept.-Oct., 1978. 2 tab., 7 ref.

Keywords: Equipment-pumps, Slurries, Design, Dairy wastes, Solids

Two suction lift helical rotor pumps, one submerged and one suction lift centrifugal pump both with a chopper and agitator, and one suction lift centrifugal pump were tested using dairy cattle manure at low (0.5%), medium (4%) and high (7%) solids content. Performance curves for each pump illustrate the head-discharge relationship, power consumption, and pump efficiency. Based on these results, recommendations are made on their suitability for various applications. (Carson-Nova Scotia Technical College)

5318-A1, B1, C1, C2, D1, D2, D3, E2, E3, F1, F2

FOOD, FERTILIZER AND AGRICULTURAL RESIDUES

R.C. Loehr, Editor
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. 727 p.

Keywords: Recycling, Land application, Methane, Waste composition, Fertilizers, Economics, Legal aspects, Sludge, Crop response, Heavy metals, Toxicity, Animal health, Waste treatment

Papers presented at this symposium explored approaches for (a) utilizing the nutrient and energy resources in municipal and agricultural residues, (b) decreasing the losses of fertilizer nutrients, and (c) avoiding environmental problems caused by residues of food production. Major topics covered were municipal sludge management and utilization, land application of wastewaters, methane production from agricultural wastes, animal waste management alternatives, fertilizer application rates and timing, and use of agricultural residues as sources of energy. An up-to-date examination of governmental regulations relating to resource recovery and land application of wastes is also included. (Merryman-East Central)

5319-A1, A8, B5, C2, E2

PERSPECTIVES ON FERTILIZER USE, RESIDUE UTILIZATION AND FOOD PRODUCTION

Bureau of Conservation and Environmental Science, Cook College, Rutgers-The State University, New Brunswick, New Jersey
R. White-Stevens
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977, p. 5-26. 5 tab., 60 ref.

Keywords: Fertilizers, Organic wastes, Recycling, Land application, Nitrogen, Nitrous oxide, Ozone

Increased use of chemical fertilizers has arisen due to: (1) the burgeoning population now over 4 billion with a current N demand of 145 million m.ton/yr., (2) improving the diet of humans, particularly among developing nations, and (3) increasing export demands for food, fiber and forestry products from the agricultural nations. Fertilizers and the maintenance of soil fertility particularly with respect to nitrogen are essential if we hope to feed, clothe and shelter the human population at even a bare subsistence level. There is no possibility that organic waste fertilization alone can provide such support for the present population, let alone the additional billions anticipated by the year 2000. The use of organic wastes can contribute about 5-10% of the need for nitrogen fertilization, but in many cases this is uneconomical and impractical. There is more promise in converting these sources of energy and protein by recycling, particularly through aquatic plants, into more acceptable and useful sources of food or feed. There is not evidence that foods grown solely on organic wastes are superior in productivity, quality, taste or nutritional value to those

raised on industrial fertilizers. The problem of the evolution of nitrogen oxides from soils fertilized with industrial-fixed nitrogen is no greater than that from those dressed with organic wastes. There is some evidence that nitrous oxide can migrate to the stratosphere and contribute to the reduction of ozone. There is no unequivocal evidence to date that man-made fixed nitrogen applied to the soil has significantly reduced the ozone layer, but this factor should be watched. (Merryman-East Central)

5320-A1, B2, B5, C2, E2 IONIC DISTRIBUTION IN A SPRAY IRRIGATION SYSTEM

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts
P.L. Deese, R.F. Vaccaro, B.H. Ketchum, P.C. Bowker, and M.R. Dennett
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 39-66. 19 fig., 5 tab., 16 ref.

Keywords: Irrigation, Sewage, Grasslands, Groundwater recharge, Nitrogen, Potassium, Phosphorus

Two agricultural sites located within Otis Air Force Base at Cape Cod, Massachusetts were used to receive spray irrigated treated sewage. It was found that spray irrigation of perennial grasses and subsequent groundwater recharge had many advantages over rapid sand filtration. The harvesting of hay removed about 50% of the nitrogen and potassium and 15% of the phosphorus applied. It was found that spray irrigation imposes a larger land requirement which leads to a commensurate increase in dilution with precipitation and groundwater as well as increased attenuation by soil. At the same time, the actual amount of water recharged will be less because of increased evapotranspiration. These factors must clearly be weighed against the higher costs of land acquisition, safe operation and maintenance and the water quantity and quality constraints of the area. (Merryman-East Central)

5321-A5, A8, B2, C1, C2, C3, E2 DEER CREEK LAKE -- ON-LAND WASTEWATER TREATMENT SYSTEM

U.S. Army Corps of Engineers, Huntington, West Virginia
D.J. Lambert and H.L. McKim
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 79-93. 2 fig., 10 tab., 3 ref.

Keywords: Sewage, Irrigation, Land application, Grasses, Nitrogen, Phosphorus, Biochemical oxygen demand, Crop response, Groundwater quality, Heavy metals

The Deer Creek Lake land treatment system is located 30 miles southwest of Columbus, Ohio, and treats the wastewater from one of the camping sites at the Deer Creek Lake Reservoir. The treatment system is composed of a stabilization lagoon, chlorine contact chamber, holding basin, pump intake, distri-

bution piping and four 3-ac spray fields. The type of crops chosen for the four 3-ac spray test plots were: alfalfa, reed canarygrass, soybeans and tree seedlings. The treatment system has been operational since 1975 and has performed adequately to meet all point discharge requirements under PL 92-500. The crop management program has shown that grasses, alfalfa and soybeans can be grown when the application rate for these permeable soils does not exceed one inch per week. The system removes nitrogen, phosphorus and BOD sufficiently to meet drinking water standards in the percolating water. (Merryman-East Central)

5322-B2, D3, E2 PHYSICAL SITING OF WASTE- WATER LAND TREATMENT IN- STALLATIONS

U.S. Army Corps of Engineers, Washington, D.C.
W.J. Hartman, Jr.
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 95-115. 9 fig., 3 tab., 1 ref.

Keywords: Wastewater treatment, Sewage, Land application, Site selection, Cropland

Engineering design parameters (soils, rate and quantity of application, soil moisture, geology and hydrology) control the design of a land treatment facility, but the design must be tempered by social, economic and environmental factors. A very difficult situation for application of the land treatment method will be in those places with the combination of the best cropland and high population density. However, it has been demonstrated that land treatment facilities can be successful in areas with moderately high population density and on the fringe of highly productive cropland. Restraining components which influence site selection for treatment by land application include: (1) farm unit density and crop production, (2) existing and future land use patterns, (3) topography (landscape values), (4), aesthetics, and (7) public involvement. Siting techniques used for land treatment facilities should combine traditional planning and design techniques for municipal wastewater treatment installations with studies of how to protect and preserve the amenities of those who live nearby. The combined information could then be applied to four siting techniques: (a) buffer area, where a certain size fringe area would be left undeveloped; (b) isolation, where the entire installation would be placed in the center of a large tract of land all of which would be under the control of the municipality or regional wastewater system manager - this technique would be similar to a watershed area, (c) natural resources preserve, an area which would be used jointly for regional or large metropolitan park purposes, wildlife preserve, forest preserve, flood plain preserve, industrial isolation preserve (atomic energy and other high-risk air pollution industries), open space preserve and land treatment of wastewater; and (d) farm-municipality cooperative where farmers of an area would join a cooperative farm operation in which each farmer would agree to utilize a certain amount of wastewater effluent for supplemental irrigation of certain crops during the year. (Merryman-East Central)

5323-B3, B5, E2, F2 NEW FEDERAL PERSPECTIVES ON THE LAND APPLICATION OF SLUDGE

Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C.
E. Clausen
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 119-124.

Keywords: Sludge, Land disposal, Legal aspects

Sludge management is gaining attention. This can be seen in many state environmental agencies, where public officials are currently deliberating over what controls and techniques are acceptable for sludge disposal in their states. It can also be seen at the federal level, where 2 recent events are helping to set the direction for future U.S. Environmental Protection Agency (EPA) policy and programming on the land disposal of sludge. These are the approval of the EPA Residual Sludge Working Action Plan and more important, the passage of the Resource Conservation and Recovery Act of 1976, PL 94-580. PL 94-580 provides for the establishment of three major programs: (1) a hazardous waste program that provides a "cradle-to-grave" system for managing hazardous wastes; (2) a land disposal program that establishes "acceptable" practices for the land disposal of hazardous wastes, and (3) a resources conservation and recovery program. The first of these are likely to affect wastewater treatment sludge land application. The implementation at the federal level with regard to sludge land disposal is limited to: (1) regulations for hazardous waste disposal, (2) criteria for determining environmentally sound land disposal practices for nonhazardous wastes and (3) promulgation of guidelines and provision of technical assistance to states and localities in the criteria implementation process. The law assures enforcement for the hazardous waste program at either the state or federal level. However, there are no federal enforcement provisions for the land disposal program. (Merryman-East Central)

5324-A11, A12, B3, E2, F2, F3 GUIDANCE ON LAND APPLICATIONS OF MUNICIPAL SLUDGE- EPA CONSTRUCTION GRANTS PROGRAM

U.S. Environmental Protection Agency, Office of Water Program Operations, Municipal Technology Branch, Washington, D.C.
R.K. Bastian
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 125-134.

Keywords: Land application, Municipal wastes, Sludge, Legal aspects, Environmental Protection Agency

The requirements of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) emphasize the need to employ cost-effective and environmentally sound waste management technology. At the same time its requirements for improved wastewater treatment will result in a nation-wide

increase in the production of sewage sludges from conventional sewage treatment processes. Since 30 to 50% of the construction costs of individual treatment plants may be clearly associated with sludge management facilities and EPA may provide as much as 75% of the capital funding required for these facilities under the Construction Grants Program, the Office of Water Program Operations (OWPO), which manages the EPA Construction Grants Program, has prepared the technical bulletin, "Municipal Sludge Management: Environmental Factors." The document will also provide designers and municipal engineers with general information for selecting optimal sludge management options, but should not be construed to be a regulatory document. In order to provide the detailed data base needed in making site-specific evaluations, the EPA is planning a series of in-depth state-of-the-art reports. One such report is "Application of Sewage Sludge to Cropland: Appraisal of Potential Hazards of the Heavy Metals to Plants and Animals" (EPA 430/9-78-013). Land application of sludge remains a controversial area, but most of the discussion centers around application to agricultural lands, especially for human food and animal feed crop production. In accordance with requirements of PL 92-500 and several recent court rulings, the EPA has embarked on an accelerated program to develop (1) pre-treatment standards for the most significant polluting industries and (2) standards pertaining to the discharge of designated toxic pollutants. A concentrated effort has been initiated to complement an effective pre-treatment program to achieve compliance with PL 92-500 provisions. Also, the agency has revised and issued pre-treatment guidelines to assist municipalities in developing local pre-treatment requirements. (Merryman-East Central)

5325-A1, A8, A9, A12, A13, C2, C3, E2, F1, F4 ENVIRONMENTAL ASSESSMENT OF MUNICIPAL SLUDGE UTILIZATION AT NINE LOCATIONS IN THE UNITED STATES

Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C.
A.D. Otte and K.V. LaConde
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 135-146. 10 tab., 4 ref.

Keywords: Land application, Municipal wastes, Sludge, Public Health, Aesthetics, Crop response, Soil contamination, Heavy metals, Economics

Nine land spreading sites representing a wide range of sludge application rates and characteristics, cropping practices, soils, climatological and geographical conditions and population densities were studied. The assessment included impact on food and nonfood chain crops, public health implications, aesthetics, plant response, soils accumulation of heavy metals and uptake by plants and cost of disposal at each site. Findings included the following: (1) Sludge management practices were found to be uncontrolled and sometimes inadequate at all nine sites. (2) There were no associated human health problems reported by any of the individuals interviewed. (3) The sludge spreading program was favorably assessed at each of the nine sites in the opinion of those interviewed, including regulatory and health

officials, newspaper editors, farmers and sewage treatment plant operators. (4) An economic analysis of the sludge disposal costs at each of the sites showed a range of \$48.00-\$130.00 per metric ton (dry weight basis). (5) Low levels of DDT and Dieldrin were found in 32% of the sludge samples. (6) PCB's were detected in significant quantities in 74% of the sludge samples. (7) Repeated sludge applications have resulted in increased surface accumulations of Cd, Cu, Ni and Zn in the sludge-treated fields. (8) Metals have not moved beyond the depth of incorporation at most sites. (9) Zn was the most mobile of the heavy metals studied. (10) A sludge having a low heavy metal content can have adverse environmental impacts if proper management practices are not followed. (Merryman-East Central)

5326-E2 LAND CULTIVATION OF INDUSTRIAL WASTEWATERS AND SLUDGES

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D.H. Bauer, D.E. Rose and E.T. Conrad
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 147-156. 2 tab., 21 ref.

Keywords: Land application, Municipal wastes, Sludge, Liquid wastes

Wastewaters and sludges that have been land cultivated are primarily from food processing, oil refinery, wood preserving, textile and pharmaceutical industries. The wastes are mainly organic and, thus, biodegradable. Land cultivation as a disposal alternative is presently practiced only by a few industries and on a limited scale in the United States. This should increase in the future. Land cultivation is viable only where soil, climate, waste characteristics and environmental conditions permit. Depending on specific conditions, the disposal program can either be related to agriculture or can be solely a disposal practice. Few comprehensive environmental monitoring programs are underway at ongoing land cultivation sites. A vast majority of states do not have statutes regulating land cultivation; thus, each instance is addressed on a case-by-case basis. (Merryman-East Central)

5327-B3, B5, E2, F1 IMPACT ON FARM COSTS AND RETURNS FROM SLUDGE APPLICATION IN FORAGE PRODUCTION

Department of Food and Resource Economics, University of Massachusetts, Amherst, Massachusetts
G.C. Reisner and R.L. Christensen
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 157-167. 2 tab., 12 ref.

Keywords: Land application, Sewage, Sludge, Economics

Studies are discussed which relate to the

economic aspects of land application of sewage sludge. In terms of agricultural economics, sludge composition and price of commercial fertilizations must be evaluated. Perhaps the most critical variable in determining the economic feasibility of land application is the distance (and cost) necessary to transport the sludge. A municipality will limit the distance carried to a point where disposal costs are equal to other alternatives. Benefits accruing to the farm are in the form of reduced expenditure for commercial fertilizer. Other benefits include organic conditioning to the soils. (Merryman-East Central)

5328-B3, B5, E2, F1 ECONOMIC ANALYSIS OF RECYCLING SEWAGE SLUDGE ON AGRICULTURAL LAND

Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio
S.L. Ott and D.L. Forster
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 169-183. 5 tab., 4 ref.

Keywords: Model studies, Sludge, Land application, Economics

This study had four objectives: (1) to design a model to select economically optimal sludge-disposal systems, (2) to apply the model to 4 representative communities in order to determine the optimal components for each, (3) to test the sensitivity of the optimal system components to the levels of critical parameters, and (4) to draw some preliminary inferences concerning the benefits resulting from land spreading of sewage sludge. Land spreading of sludge was found to be a low-cost alternative for the four modelled communities which represented a wide range in important characteristics such as community size, soil type, distance to disposal site, sludge characteristics and local cropping practices. It was found that application rates should be based on that nutrient in sludge which first satisfies the particular crop needs. Crop nutrients are wasted if any of the important nutrients (nitrogen, phosphorus or potassium) are supplied in excess of crop needs. The low sludge application rates resulting were found to increase substantially the number of acres to which sludge is applied. If farmers reimburse the city for the extra land spreading costs incurred in spreading at relatively low application rates, the city's desire to spread at high rates may be alleviated. For communities producing relatively small quantities of sludge, high capital investments in spreading equipment may preclude land spreading of sludge. However, for communities producing above approximately 350 dry tons of sludge per year, land spreading appears to be a low-cost alternative. Dewatering sludge is beneficial only when hauling distances are relatively long or percent solids in the sludge are low. (Merryman-East Central)

5329-A3, A4, A5, B5, C2, E2 CROP YIELDS AND WATER QUALITY AFTER APPLICATION OF SEWAGE SLUDGE TO AN AGRICULTURAL WATERSHED

Agricultural Research Service, U.S. Department of Agriculture, St. Paul, Minnesota
C.E. Clapp, D.R. Duncomb, W.E. Larson, D.R. Linden, R.H. Dowdy and R.E. Larson
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 185-198. 1 fig., 7 tab., 10 ref.

Keywords: Land application, Sewage, Sludge, Crop response, Grasses, Nitrogen, Phosphorus, Potassium, Heavy metals, Agricultural runoff, Soil water, Water quality

The overall objective of this study was to develop efficient, practical and environmentally safe methods for applying sewage sludge to land in harmony with agricultural usage. A summary is presented of crop yields and water quality on an agricultural watershed that had received sewage sludge applications for three years. Total sludge applications through 3 growing seasons were 17 cm on the corn areas and 13 cm on the grass areas. These amounts were equivalent to 28 and 20 m.ton/ha total solids and 1610 and 1260 kg/ha total N, respectively. Corn yield means for 3 seasons were 13.8 m.ton/ha fodder and 6.4 m.ton/ha grain on the sludge-treated land. Reed canarygrass dry matter yields for one cropping season were 7.8 m.ton/ha on the fertilized control area and 9.7 m.ton/ha on the sludge-treated areas. Plant tissue showed normal concentrations of N, P and K with no increase in heavy metal contents due to sludge applications. Total N ($\text{NO}_3\text{-N} + \text{NH}_4\text{-N}$), soluble P ($\text{PO}_4\text{-P}$) and K in runoff water averaged 2.8, 0.05 and 0.4 kg/ha for the control area and 29, 0.23 and 0.6 kg/ha for the sludge-treated areas, respectively. Soil water samples showed some movement of nitrate-N to the 150 cm depth on the sludge-treated corn areas, but no increase over the control for the grass areas. Phosphate-P increased at the 60 cm depth for the corn areas only. Concentrations of heavy metals in soil water were not increased by sludge application. (Merryman-East Central)

5330-A11, B3, C2, E3 NUTRIENT USAGE AND HEAVY METALS UPTAKE BY SHEEP FED THERMORADIATED, UNDIGESTED SEWAGE SOLIDS

Department of Animal and Range Science, New Mexico Agricultural Experiment Station, New Mexico State University, Las Cruces, New Mexico
G.S. Smith, H.E. Kiesling, and H.D. Slivinski
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 239-254. 7 tab., 26 ref.

Keywords: Refeeding, Sewage, Solid wastes, Sheep, Performance, Economics, Heavy metals, Trace metals

The purpose of this study was to extend observations on the nutritive value of thermoradiated sewage products used as supplements in feeds for ruminants, and to assess the retention of heavy metals and certain trace elements by sheep fed sewage products and subsequently fed a conventional diet. The sheep were fed basal, fibrous "poor quality" (low nitrogen) diets in comparison with equal intakes of basal components plus supplemental cottonseed meal vs. thermoradiated, undigested sewage solids. Digestibility of basal components was apparently improved by

supplements, and sewage solids compared favorably with cottonseed meal. Experimentation to date is sufficient to provide conclusions regarding potential hazards of refeeding sewage solids. Wide variations in composition of sewage preclude generalizations. Nevertheless, experimental results indicate that economically important amounts of nutrients are involved and usable by ruminant animals. At current prices for conventional protein supplements, the feeding value of "raw" solids from domestic sewage projects easily into the range of \$100 or more per ton. Perhaps sometime in the future, for some cities, the development of a "feedstuff industry" may well replace the typical sanitation district and thus provide the incentive to "decontaminate" the products of domestic waste. (Merryman-East Central)

5331-B5, C2, E2 THE ECONOMIC TRADE-OFFS OF COMMERCIAL NITROGEN FERTILIZERS, LEGUMES AND ANIMAL WASTES IN MIDWEST AGRICULTURE

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T.J. Consideine, R.E. Muller, Jr., R.M. Peart, and O.C. Doering III
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 299-317. 4 fig., 9 tab., 13 ref.

Keywords: Model studies, Fertilizers, Animal wastes, Land application, Economics, Nitrogen, Phosphorus, Potassium, Waste composition

This chapter focuses on the technical and economic feasibility of cropping technologies which economize on nitrogen fertilizer. Two cropping technologies are evaluated. The first involves the inclusion of nitrogen-fixing legumes into cropping rotations. The second technology considered is the application of animal wastes to replace commercial fertilizers. Three analytical models were linked together for technical and economic analysis of these alternatives: an agricultural energy input-output simulator, a linear programming farm management model and a livestock feed ration model. It was found that the use of animal waste as a complete fertilizer is profitable under current prices. However, this depends to a large extent upon timeliness and machinery constraints. The use of vetch as a source of nitrogen for corn is not profitable under current prices. However, the economic analysis did not value the possible benefits due to reduced soil erosion. The key resource trade-off discovered in the analysis involved energy and labor. The adoption of less energy-intensive cropping technologies enables a lower energy input per unit of land. However, it also results in a higher ration of labor to energy. Thus, a key consideration in evaluating the possibilities for the adoption of energy-saving cropping technologies would be the supply of labor and the competing demands for that labor within the agricultural sector. (Merryman-East Central)

5332-A1, A3, B1, B5, C2, E2, F1 A LINEAR PROGRAMMING MODEL FOR DAIRY FARM NU-

TRIEN MANAGEMENT

Departments of Agricultural Engineering and Environmental Engineering, Cornell University, Ithaca, New York
D.A. Heath and D.W. Atkinson
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 319-332. 13 tab., 17 ref.

Keywords: Model studies, Dairy wastes, Land spreading, Nitrogen, Phosphorus, Economics, Agricultural runoff

A relatively simple dairy farm linear programming model was developed and tested which focuses on the nutrient budgets of the dairy farm and which determines an optimal set of cropping, manure spreading, nitrogen application and herd size decisions subject to constraints on farm losses of nitrogen, phosphorus and eroded soil. The model was a more modest version of an earlier, detailed farm management model which was tested using field data. Results of both models were found comparable. The new model can be used to determine the effects of dairy farm management decisions on farm income and on water pollutant losses from the farm. It is also a suitable tool for the evaluation of environmental policy decisions of farm management. However, the model is not recommended for detailed farm budgeting or planning studies. Rather the model would appear to be a reasonable mechanism for the screening of research and policy options to determine their likely impact on both the dairy farm and the environment. (Merryman-East Central)

5333-B1, D3, E3, F1 THE ROLE OF AN ANAEROBIC DIGESTER ON A TYPICAL CENTRAL IOWA FARM

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R.J. Smith, R.L. Fehr, J.A. Miranowski and E.R. Pidgeon
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 341-371. 6 fig., 14 tab., 37 ref.

Keywords: Digesters, Anaerobic, Energy, Methane, Recycling, Economics

This hypothetical study which utilized experimental data from a concurrent study with a 100-gal. pilot anaerobic digester which was fed beef manure, had the following objectives: (1) To establish the characteristics of a typical central Iowa farm. (2) To analyze fossil-fuel and electrical-power use on the farm for each unit process. (3) To design unit processes for handling all aspects of livestock production, residue processing and produced fuel use when anaerobic digestion for methane production is incorporated. (4) To assemble cost data for use in economic-optimization models. (5) To apply linear-programming techniques to the farm operation to predict profitability and to show what flexibility of response the producer will have to fluctuating markets for his grain and animal products. (6) To produce preliminary plans for implementing anaerobic digestion on a typical 320-ac farm. The economic feasibility of an on-farm methane-digester system, premised upon the assumptions of this analysis, was found questionable

within a responsible range of energy-price rises. It is most unlikely that such a digester can be justified by its energy-recovery potential alone. Other selling points might be that the odor from a digester, operating well is very slight; the stabilization process itself can certainly be made energy self-sufficient; and digestion systems seem compatible with other labor-saving improvements in confined-livestock production. However, a word of caution is desirable. What is scientifically achievable may not be entirely desirable on the farm. The long-term consequences of surrounding a farmer with more and more complex equipment (including methane digesters) need thorough examination. (Merryman-East Central)

5334-B2, D3, E3 EXPERIENCES FROM OPERATING FULL-SIZE ANAEROBIC DIGESTER

Agricultural Engineering Department, The Pennsylvania State University, University Park, Pennsylvania
S. Persson, H.D. Bartlett, R.W. Regan, and A.E. Branding
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 373-379. 1 fig.

Keywords: Digesters, Anaerobic, Design, Biogas

The Penn State biogas generator was designed to process the gutter discharge from 50 lactating Holstein dairy cows. Components of this system include a heated anaerobic digester with floating dome and recirculated biogas agitation. The biogas generation system was seeded with sewage sludge in late December, and increasing weekly increments of manure were added until the total manure production from the barn was supplied to the digester by the end of January, 1977. By that time, biogas production was sufficient to operate the boiler continuously. Thereafter, gas in excess of the heating system needs was produced. (Merryman-East Central)

5335-B2, C1, C2, D3 ANAEROBIC FERMENTATION OF ANIMAL WASTES: DESIGN AND OPERATIONAL CRITERIA

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G.R. Morris, W.J. Jewell, and R.C. Loehr
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 395-413. 8 fig., 4 tab., 22 ref.

Keywords: Design, Fermentation, Anaerobic, Mathematical models, Model studies, Waste composition

Comprehensive laboratory and theoretical investigations were conducted to: (1) evaluate the effects of process design or operational variables on the anaerobic fermentation process, (2) determine reaction relationships in order to predict the effluent quality from an anaerobic system treating animals, and (3)

develop mathematical expressions which will permit the use of the reaction relationships for the design and operation of effective anaerobic waste treatment systems. Because dairy manure constitutes a major portion of farm animal wastes and is a fairly good illustration of the complexity involved in animal wastes, it was decided that dairy manure would be an appropriate substrate. Two types of bench-scale, manually mixed anaerobic fermentation systems were constructed and operated under controlled laboratory conditions. Experimental results were evaluated in terms of: (a) characteristics of dairy cow manure; (b) biodegradability of dairy cow manure; and (c) digester performance at steady-state conditions. Study results gave information which assisted in the development in a mathematical design approach. The mathematical approach developed in this study appeared to be able to predict the effluent characteristics of bench-scale anaerobic treatment systems reasonably well. The predictions were generally within about 5% of the actual effluent concentration. Based on the information developed from the mathematical relationships, it is suggested that anaerobic systems digesting dairy manure should be designed for and operated at hydraulic retention times of at least ten days. Additional consideration should be given to the influential substrate concentration when selecting design and operational criteria, since influent volatile solids concentration has an effect on the performance of the treatment system. A summary of the empirical expressions involved in process design and operation is given. (Merryman-East Central)

5336-B2, C1, C2, D3, F1 A COMPARISON OF AN ANAEROBIC DIGESTOR AND AN AERATION SYSTEM TREATING PIGGERY WASTE FROM THE SAME SOURCE

The North of Scotland College of Agriculture, Aberdeen, Scotland
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Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 415-422. 2 fig., 3 tab., 3 ref.

Keywords: Waste treatment, Swine wastes, Slurries, Anaerobic digestion, Aeration, Effluent quality, Economics, Waste composition

This chapter compares the results of an anaerobic and an aeration/separation system operating on the same source of piggery waste. A comparison of effluent quality and costs is given. The costs are those of operating an experimental field-scale plant, but they have been extrapolated to larger but simpler systems to project the place of each process as a treatment system in on-farm situations. While previously anaerobic digestion was only of interest as an energy-producing process, it can be shown that anaerobic digestion can be economical as a treatment process for units with about 100 breeding sows. Anaerobic digestion does not provide such a high quality effluent as aeration, but it handles the whole slurry in one stage and preserves all the nutrient content of the raw material. (Merryman-East Central)

5337-B2, C2, D3, E3

ANAEROBIC DIGESTION OF POULTRY WASTE WITH AND WITHOUT ACID HYDROLYSIS PRETREATMENT

Department of Agricultural Engineering, University of Hawaii at Manoa, Honolulu, Hawaii
P.Y. Yang and K.K. Chan
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 423-435. 10 fig., 3 tab., 7 ref.

Keywords: Anaerobic digestion, Poultry wastes, Hydrolysis, Methane, Chemical oxygen demand, Alkalinity, Volatile acids, Volatile solids

In order to improve anaerobic digestion, the present study was initiated to investigate the feasibility of increasing the digestion rate and gas production rate by pretreatment of organic waste. Heat and acid hydrolysis were used to break down the complex components in organic waste into small simpler fragments in a relatively short period of time or to take over a large part of the activity performed by hydrolytic enzymes. Eight batches of poultry waste with different initial total COD concentrations with and without acid hydrolysis were prepared and subjected to the anaerobic digester process with daily averaged ambient temperature ranging from 29.7 to 33°C. It took about 17 days to stabilize the total COD content in the hydrolyzed system and 23 days in the nonhydrolyzed system. In addition, the rate of accumulation of volatile acid content in the nonhydrolyzed system was higher than in the hydrolyzed system within the first 8 days of operation. The alkalinity content in the hydrolyzed system was higher than in the non-hydrolyzed system. The average value of the methane gas from the hydrolyzed waste was 81.8% and was 20.5% for the nonhydrolyzed waste. Study results would seem to indicate that gas production rate in the hydrolyzed system should be greater than in the nonhydrolyzed system within a certain range of substrate concentrations, because the equilibrium constant in the former system is less than in the latter. (Merryman-East Central)

5338-B5, E2, F1 AN ENERGY AND ECONOMY ANALYSIS OF CONVENTIONAL AND ORGANIC WHEAT FARMING

Department of Natural Resources, Cornell University, Ithaca, New York
G.M. Berardi
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 439-447. 1 fig., 1 tab., 17 ref.

Keywords: Energy consumption, Economics, Land application, Organic wastes, Fertilizers

To determine if wheat could be produced economically with minimal amounts of fossil energy, a comparison was made between wheat produced by organic farming (low energy) practices and conventional farming (high energy) profitability of producing wheat by conventional and organic farming methods in the northeastern United States. Twenty

farms growing winter wheat in New York and Pennsylvania were selected for the study. Ten farms used conventional commercial fertilizers and ten used organic fertilizers (animal manures and green manures). The organic farms employed a hay-corn-wheat rotation and regularly applied an average of 40.4 kg of nitrogen (98% was commercial synthetic nitrogen and 2% was of plant and animal origin). Yields, energy inputs, economic profitability and labor inputs were measured in each case and then compared. There was no significant difference in economic profitability between wheat produced by conventional and that produced by organic farming practices in this sample. Extrapolation to the larger sample of conventional and organic farmers in the Northeast is impossible at this point until further research is performed. Nevertheless, perhaps some of the methods practiced by the organic farmers (use of older equipment, less equipment, green manures, etc.) should have stronger support in research and extension work, particularly for small-scale wheat operations. (Merryman-East Central)

5339-A8, A9, B2, B5, C2, E2 EFFECTS OF POULTRY WASTE EFFLUENT AND INSECTICIDES ON CORN PRODUCTION

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*Food, Fertilizer and Agricultural Residues:
Proceedings of the 1977 Cornell Agricultural
Waste Management Conference.* Ann Arbor
Science Publishers, Inc., Ann Arbor, Michi-
gan, 1977. p. 509-520. 5 fig., 1 tab., 12 ref.

Keywords: Poultry wastes, Effluent, Insecti-
cides, Crop response, Land application,
Fertilizers, Nitrogen

Research was done to determine the effect of poultry waste effluent and matching fertilizer solutions on corn seedlings under growth-chamber conditions. The digestors were maintained under anaerobic conditions, because this probably more closely approximated actual farm operations. Nitrogen content of the effluent was considered to be an important parameter affecting plant growth. During the progress of the research, it was determined that insecticides were used at the poultry house under warm-weather conditions to control the fly population. Since this poultry house was the source of manure for the studies conducted, additional experiments were done to determine the effect of the insecticides on the *E. coli* population in the manure and on plant growth. The poultry waste effluent was applied to 1- to 3-week-old corn seedlings over a 1- to 2-week period. It was found that application of poultry waste effluent during this period of time produced maximum growth when the nitrogen levels were 125 to 200 lb N/ac (140 to 224 kg N/ha). Matching fertilizer control solutions consistently produced significantly higher yields than the poultry waste effluent. Mixed and nonmixed poultry waste effluent produced similar results when applied to corn plants. Dimethoate (an insecticide) eliminated the *E. coli* population in poultry waste at concentrations of 2000 to 3000 ppmv. Poultry manure effluent containing dimethoate (> 25 lb/ac) could cause corn injury. (Merryman-East Central)

5340-A6, B2, C1, C2, D3, E3, F1,

F2 PRACTICAL APPLICATION OF AEROBIC TREATMENT AND LAND APPLICATION OF POUL- TRY MANURE

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ciates, Inc., Montgomery, New York
A.C. Anthonisen and D.H. Wagner
*Food, Fertilizer and Agricultural Residues:
Proceedings of the 1977 Cornell Agricultural
Waste Management Conference.* Ann Arbor
Science Publishers, Inc., Ann Arbor, Michi-
gan, 1977. p. 521-531. 4 fig., 7 tab.

Keywords: Odor control, Oxidation ditch,
Poultry wastes, Recycling, Design, Legal
aspects, Waste composition, Economics

Mountain Pride Farms had to develop an effective system for odor control in order to meet the requirements of a New York State Department of Environmental Conservation Consent order. The management system selected included the use of oxidation ditches. Design, construction, and operation of the system is discussed. Comparisons between those buildings with the oxidation ditch system and those without clearly demonstrated that odor control was achieved. A secondary objective of utilizing the oxidation ditch mixed liquor was also demonstrated through a successful marketing program to area crop farmers. The resource value of aerated poultry manure, in terms of a feed supplement, is presently being investigated at Cornell University. It is hoped that, through the results of these studies, more economically effective methods for using the nutrients synthesized during the aeration process will be demonstrated. (Merryman-East Central)

5341-A6, B1, D1, D3, F1 ECONOMIC COMPARISON OF THE OXIDATION DITCH AND HIGH-RISE MANURE DRYING AS POULTRY WASTE MANAGE- MENT ALTERNATIVES

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*Food, Fertilizer and Agricultural Residues:
Proceedings of the 1977 Cornell Agricultural
Waste Management Conference.* Ann Arbor
Science Publishers, Inc., Ann Arbor, Michi-
gan, 1977. p. 533-547. 5 fig., 9 tab., 7 ref.

Keywords: Poultry wastes, Waste treatment,
Economics, Oxidation ditch, Dehydration,
Odor control

An analysis is presented of the costs associated with use of the oxidation ditch and high-rise undercage drying as poultry waste management alternatives. Also included is an estimate of labor requirements for ultimate disposal. It was found that drying represents a least-cost alternative for odor control. Total cost for high rise drying excluding labor and operating costs for ultimate disposal was estimated to be \$0.01 per dozen eggs. Comparative cost for the batch-reactor oxidation ditch alternative was \$0.032 per dozen eggs. High waste stabilization costs for this type of oxidation ditch result from the inefficiency of oxygen transfer in poultry manure slurries with high mixed liquor total solids concentrations. Maximizing oxygen transfer efficiency would reduce costs to a

level approaching \$0.014 per dozen eggs.
(Merryman-East Central)

5342-B3, C1, C2, D1 MANAGEMENT OF LAYING HEN MANURE BY MOISTURE RE- MOVAL --RESULTS OF SEVERAL RESEARCH INVESTIGATIONS

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*Food, Fertilizer and Agricultural Residues:
Proceedings of the 1977 Cornell Agricultural
Waste Management Conference.* Ann Arbor
Science Publishers, Inc., Ann Arbor, Michi-
gan, 1977. p. 549-579. 10 fig., 12 tab., 2 ref.

Keywords: Dehydration, Poultry wastes, De-
sign, Moisture content, Waste composition

Investigations were made on various methods to promote drying under the caged birds, on the use of unheated air for drying on the direct measurement of manure moisture and on a procedure for calculating the component changes through a management system. A theoretical approach was directed towards determining the resulting moisture content when a percentage of the manure is partially dried and then mixed with the remaining manure. This theory was applied to data obtained from studies utilizing metal fins, wires, metal strips and metal ridges. In all cases studied the final moisture content was above that required for handling manure as a solid. The lowest final moisture content contained 62%, wet basis. A pilot scale belt dryer using unheated air and capable of handling manure from 120 birds was designed and constructed. The drying time was 24 hr. and final moisture content was as low as 10%, wet basis. With a small number of experimental conditions investigated and without checking all commercially available equipment, there appears to be the possibility of obtaining approximate moisture contents of partially dried manure by means of electrical resistance methods. Further investigation and calibration is needed. Based on the assumption that fixed solids remain constant throughout the movement of a waste within a manure management system, these fixed solids can be used as a tracer to calculate changes occurring to a component of the waste. A summary of these changes for various systems is detailed. (Merryman-East Central)

5343-A6, B3, C1, C2, D1 STORABILITY OF PARTIALLY DRIED LAYING HEN MANURE

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*Food, Fertilizer and Agricultural Residues:
Proceedings of the 1977 Cornell Agricultural
Waste Management Conference.* Ann Arbor
Science Publishers, Inc., Ann Arbor, Michi-
gan, 1977. p. 581-598. 8 fig., 10 tab.

Keywords: Waste storage, Dehydration,
Moisture content, Nitrogen, Dried poultry
wastes, Odor

To utilize manure properly and at the same time improve environmental quality, manure

must be stored perhaps for several months. Studies were conducted to investigate storage of partially dried poultry manure and the changes that occur during storage. The first study was carried out in plastic bags and the second in bins. The bag study simulated rapid drying of manure in thick layers. The bin study simulated the conditions in a large pile. It was found that while best conservation of organic-N and best odor control was accomplished by drying to 15%, time and energy requirements were too great. Conservation of nitrogen, odors and handleability were acceptable at 30% moisture which required less time and energy. The bin study indicated that poultry manure dried to about 30% moisture could be stored without any adverse effects when the piles are built in layers (10 cm was the maximum layer thickness tested). Manure stored in piles built in thin layers (2.5 cm) suffered greater losses of organic matter and organic nitrogen. (Merryman-East Central)

5344-D3, E3 MANURE RESIDUE AS A SUBSTRATE FOR PROTEIN PRODUCTION VIA *HERMETIA ILLUCENS* LARVAE

Department of Agricultural Engineering, Georgia Coastal Plain Experiment Station, Tifton, Georgia
C.V. Booram, Jr., G.L. Newton, O.M. Hale, and R.W. Barker
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 599-604. 3 tab., 6 ref.

Keywords: Animal wastes, Substrates, Flies, Larvae, Refeeding, Nitrogen, Protein

Study objectives were: (1) to evaluate *Hermetia illucens* (the soldier fly) as a possible nutrient source for swine rations; (2) to characterize the larvae meal chemically; (3) to consider the differences in composition of resulting feces when soybean meal or *Hermetia illucens* larvae are used as a dietary source of protein. During the summer of 1974, *Hermetia illucens* larvae were harvested three times from anaerobic cattle manure storage pits. The larvae were separated from the wastes, dried, and ground. The ground larvae were combined with an antioxidant and then frozen until it was utilized experimentally. Two 20% protein diets were prepared using *Hermetia illucens* larvae as the protein source for one diet and soybean meal for the second diet. The two diets were fed to weanling pigs. Refeedings of the larvae to weanling pigs indicated that although the difference in apparent nitrogen digestibility was small, it was significant and was in favor of the soybean meal diet. Currently laboratory work is under way to investigate the possibility of mass rearing of *Hermetia illucens*. With this basic information, an environmental system will be developed that will allow the waste to be seeded with *Hermetia illucens* eggs and grown to a harvestable size. The benefits are twofold: production of protein and treatment of livestock wastes. (Merryman-East Central)

5345-A8, B2, C2, E2 LAND APPLICATION OF SWINE WASTE RESIDUE FOR INTEGRATED CROP PRODUCTION

Department of Agricultural Engineering, Georgia Coastal Plain Experiment Station, Tifton, Georgia
C.V. Booram, Jr.
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 605-620. 19 tab., 17 ref.

Keywords: Land application, Swine wastes, Liquid wastes, Crop response, Water quality, Soil contamination, Nitrogen, Potassium, Phosphorus, pH, Trace metals, Waste composition

The ability of agricultural land to serve as a receptor for the application of anaerobic swine residues when the land is to be used for feed-grain production was evaluated. Excess lagoon liquid was applied to about 6 acres of poorly drained Clarion-Webster complex soil with a maximum slope of 4%. The seedbed was prepared by plowing, disking, and harrowing before planting. After seedbed preparation, the plots were planted with Pioneer 3388 corn seed at a rate of 30,000 plants/ac, and Atrazine was applied to the plots for preemergence weed control. Two years of data suggest that the application of animal wastes to soil will cause increases in conductivity and exchangeable potassium and a slight decrease in pH. Application rates, based on nitrogen, greater than 450 to 500 lb/ac seem to cause greater increases in conductivity and exchangeable potassium. As more and more wastes are applied to the soil, the ability of plants to remove plant nutrients and micronutrient metals is reduced. Logically this means that metals can increase in the soil. If swine waste applications are limited by the requirements of nitrogen, phosphorus and potassium, a buildup of micronutrients is not likely to occur. Salinity was not found to be a problem. (Merryman-East Central)

5346-A6, A11, C2, C3, D3, E3 A FERMENTATION PROCESS FOR THE UTILIZATION OF SWINE WASTE

Northern Regional Research Center, Agricultural Research Service, U.S. Department of Agriculture, Peoria, Illinois
B.A. Weiner
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 621-635. 4 fig., 6 tab., 19 ref.

Keywords: Swine wastes, Refeeding, Fermentation, Lactic acid, Odor, Coliforms, Performance, Swine, Poultry, Sheep, Waste composition

Aerobic fermentation of swine waste combined with cracked corn produced differences in microbial and biochemical patterns dependent on use of fresh or stored excrement. Lactic acid fermentation and a silage-like odor resulted with both wastes. Coliforms present initially at 10^5 organisms/dry g in stored waste-corn cultures were not detected after 36 hr; coliforms in fresh waste-corn fermentations persisted at 10^4 organisms/dry g. However, acid production in fresh waste-corn flasks was increased over 27% by 0.1 replacement of starting fermentations with waste-corn cultures, 48 hr. old, equivalent to an inoculum of lactic acid organisms. When the fermentation product from waste-corn cultures was fed as the major dietary component

to young pigs, the pigs on the waste-corn diet gained about 1/3 the amount gained by the control group. Laying hens receiving the waste-corn diet performed comparably to control during a 21-day test. The corn-waste diet was accepted by sheep. Thus, the product appeared to be well accepted by monogastrics, ruminants and poultry. Refeeding swine waste in the form of fermentation product without the drying required for storage suggests a feasible way of decreasing the waste problem of swine feedlots by one-third and could provide augmented animal diets with attendant economic advantages. (Merryman-East Central)

5347-B2 THERMOPHILIC AEROBIC DIGESTION OF DAIRY WASTE

Department of Agricultural Engineering, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York
R.J. Cummings and W.J. Jewell
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 637-657. 9 fig., 1 tab., 12 ref.

Keywords: Aerobic, Digesters, Design, Slurries, Dairy wastes

This study was conducted to define the requirements of the process of auto-heating during aerobic digestion of a complex organic slurry and to demonstrate the feasibility of the process with a full-scale commercially available unit. The study was designed to define the major variables of operation in such a manner that the data could be extrapolated to other organic slurries. Dilute dairy cow manure was used as the feed throughout the study. Design of the digestion system is described in detail. Study results indicated the following: (1) Concentrated organic slurries could be rapidly stabilized at thermophilic temperatures. The reaction rate coefficient (K_T) doubled when the temperature of the reactor contents was increased from 31 to 40°C. (2) Thermophilic temperatures were achieved with autoheating with a simple air aeration system. (3) Insulation of the reactor and oxygen transfer efficiencies of 12 to 36% enabled autoheating to be effective. (4) Heat losses through the surface area of the reactor and due to aeration were quite small at all loadings due to the insulation and efficient oxygen transfer. (5) Heat loss in the effluent liquid (H_L) was the most significant loss from the system. At high loadings of 42.6 g COD/liter reactor-day, H_L was four times the combined effects of all other heat losses. (6) High loading rates of up to 9 g BOD/1-day resulted in 80% removal of the biodegradable substrate in 3 days HRT. The reactor temperature was 36°C above the ambient air temperature. (Merryman-East Central)

5348-A5, A6, B2, C1, C2, C3, D3, E2 PERFORMANCE OF AN ANAEROBIC WASTE TREATMENT LAGOON SYSTEM

Agricultural Engineering Department, The Ohio State University, Wooster, Ohio
R.K. White, R.L. Curtner, and R.H. Miller
Food, Fertilizer and Agricultural Residues:

Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 659-679. 15 fig., 3 tab., 1 ref.

Keywords: Anaerobic, Lagoon, Livestock wastes, Sewage, Biological treatment, Waste composition

A two-stage anaerobic lagoon system for treating livestock wastewaters and sanitary sewage from the Ohio State University Animal Science Livestock Center was monitored from 1974 through 1976. Swine wastes and beef runoff were pumped to the lagoon system. Sewage from student workers' living quarters and public restrooms were pumped to the lagoon separately. The following reductions were achieved in the first stage of the system: 82% for TS, 92% for TSS, 92% for BOD and 85% for COD. The total nitrogen in the mixed liquor of the first and second lagoon varied from 140 to 180 mg/l and 10 to 50 mg/l, respectively. From a nutrient recovery viewpoint, it would be best to irrigate from the first lagoon. Wastewater irrigation will begin either in the fall of 1977 or the spring of 1978. Microbiological analyses of the lagoon over the two-year period indicated that the lagoon matured and the bacteria stabilized at consistently low populations. Bacteria count data and conductivity data indicated that seepage from the bottom of the lagoons stopped or markedly decreased after 1975. This would give a period of almost three years for sealing of the lagoon bottoms to transpire. Odor was only offensive during the initial startup of the lagoon. (Merryman-East Central)

5349-B2, B4, C1, C2, E2 **NUTRIENT BUDGET IN A DAIRY ANAEROBIC LAGOON-EVALUATION FOR LAND APPLICATION**

Department of Agronomy and Soils, Washington State University, Pullman, Washington D.F. Bezdicsek, J.M. Sims, M.H. Ehlers, J. Cronrath, and R.E. Hermanson
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 681-692. 1 fig., 6 tab., 18 ref.

Keywords: Dairy wastes, Lagoons, Anaerobic, Land application, Waste composition, Irrigation, Nitrogen, Phosphorus, Calcium, Magnesium

A surface-aerated anaerobic lagoon was studied which received wastes from a 65-Holstein-cow dairy lot at the Knott Dairy Center, Washington State University. The high-solids lagoon was a 430 m³ earthen storage facility. A floating 2- and a 3-hp Aqua Jet Aerator minimized odors and kept a surface crust from forming. During rainy periods, effluent from the high-solids lagoon flowed through a collection tank into a 14,000 m³ low-solids lagoon. Water was supplied from the low-solids lagoon to the high-solids lagoon to aid in sludge dilution during pumpout and to flush the pipeline after pumpout. The low-solids lagoon was emptied during the summer onto land with conventional irrigation sprinkler. Waste concentrations were found similar during the three experimental periods (spring, summer, and winter). Reduction in total solids and volatile solids averaged 46 and 52%, respectively. Average recovery of Total Kjeldahl Nitrogen was 71%. Phosphorus, calcium and magnesium recoveries averaged 70, 62, and 76% respectively.

Potassium recovery averaged 84%. Spring simulator data indicated that effluent represented 83.9% of the total waste volume. Only 50% of the nitrogen, phosphorus, and magnesium were in the effluent and only 10% of the calcium was retained there. This reveals the importance of sludge recovery for its nutrient value. Lagoon performance varied with the seasons. Sludge was removed most easily in the summer because gas production by microbial activity appeared to suspend the solids with a minimum of agitation. Good nutrient recoveries were obtained in the spring from the addition of water to resuspend the solids when the slurry was too thick to pump. Slightly lower volume and nutrient recoveries were obtained during the winter due to an unpumpable slurry remaining at the end of the pumpout. 13.8 ha of land were found to be required to accommodate the annual manure production from this 65-cow dairy — an amount more than three times greater than estimated in published guidelines. (Merryman-East Central)

5350-A8, B2, B5, C2, E2 **EFFECT OF MANURE ON PLANT GROWTH AND NITRATE IN SOIL WATER**

Department of Agronomy, The Pennsylvania State University, University Park, Pennsylvania L.F. Marriott, H.D. Bartlett, and M.J. Green
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 693-700. 3 fig., 2 tab., 1 ref.

Keywords: Dairy wastes, Land application, Soil injection, Soil water, Water quality, Soil-water-plant relationships, Nitrogen

Dairy wastes from a dairy barn at The Pennsylvania State University were injected under an established orchard grass sod at rates to supply 340, 450, and 560 kg N/ha in November, 1973 and April, 1974. The treatments were repeated on the following November and April. Urea was topdressed at 112 kg N/ha in April, 1974 and 1975 as a control. No treatments were applied for the 1976 season. Soil water for nitrate-nitrogen determinations was collected from suction lysimeters installed at depths of 30, 60, 90, and 120 cm. Over the three-year period, the spring manure application resulted in slightly higher yields and 7 to 10% more N removed in the forage. There was a trend toward higher yields with increasing manure rates in the first and residual years, but the differences were not sufficient to justify a rate higher than the lowest rate used. The high yields and nitrate levels in soil water indicate that 340 kg N/ha appears to be excessive for an annual application rate for this crop. The variability in nitrate-N concentrations under injected manure prompted an experiment in which the manure was evenly broadcast over small plot areas of Kentucky bluegrass adjacent to the orchardgrass study. A valid comparison of movement of nitrate-N from injected and broadcast manure is not possible because of use of different grasses and application in different years. Study results would seem to indicate that an annual rate of 250 to 300 kg N/ha would maintain yields with minimum pollution to soil water. (Merryman-East Central)

5351-A11, B3, C1, C2, D3, E3

NUTRITIONAL VALUE OF ENSILED CROP RESIDUE CATTLE WASTE MIXTURES

Animal Science Department, Fort Valley State College, Fort Valley, Georgia W.L. Braman and R.K. Abe
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 701-709. 8 tab., 9 ref.

Keywords: Refeeding, Ensiling, Cattle wastes, Cattle, Performance, Crop residues

A series of investigations were conducted to study the use of ensiled crop residues and cattle wastes (feces and urine) mixtures as cattle feed. The investigations revealed the following: (1) Waste from cattle fed high-concentrate diets (finishing diets) excelled waste from cattle fed high-roughage diets in nutritional potential for beef cattle. (2) The most desirable combination of fermentation, nutritional and physical characteristics observed with cattle waste-crop residue silage mixtures contained 40 to 60% wet cattle waste originating from cattle fed high-concentrate diets. (3) The feeding of an ensiled cattle waste-peanut hulls mixture to growing heifers resulted in decreased daily gain (8%) and feed efficiency (12%), but it resulted also in decreased feed cost per kg of gain by 16%, compared to heifers fed coastal Bermudagrass hay. (4) First-calf heifer performance was not affected by the feeding of an ensiled cattle waste-peanut hulls mixture compared to a conventional feeding program. (5) Additional information is needed to determine the effect of the long-term feeding of cattle waste to the beef cow herd upon herd health and reproductive performance. (Merryman-East Central)

5352-B2, D3, E2, F1 **ECONOMIC IMPLICATIONS OF WASTE EFFLUENT REGULATIONS FOR MINNESOTA DAIRY PROCESSING PLANTS**

Economic Research Service, U.S. Department of Agriculture, St. Paul, Minnesota B.M. Buxton, W.J. Ziegler, and J.A. Moore
Food, Fertilizer and Agricultural Residues: Proceedings of the 1977 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1977. p. 711-721. 3 fig., 1 tab., 9 ref.

Keywords: Regulations, Pollution control, Water pollution, Dairy industry, Economics, Wastewater treatment, Stabilization pond, Lagoon, Ridge and furrow, Land application

This chapter evaluates the economic impact of wastewater effluents regulations on the Minnesota dairy processing industry. It was estimated that in 1975, about 68% of Minnesota's dairy processing plants discharged wastewater into municipal sewer systems. Given the current status of wastewater treatment by Minnesota municipalities, dairy plants that are using these systems can expect substantial increases in sewer use charges due to pollution controls imposed on municipalities, many of which are having to construct new or to remodel existing wastewater treatment systems. In 1975, about 16% of the dairy plants in Minnesota were found to be inadequate. Dairy processing plants discharging wastewater directly to receiving waters or

using private treatment that may not meet water quality regulations must consider alternative ways to come into compliance. Plants using municipal waste systems but facing substantial increases in use charges may also consider an alternative private waste treatment system. Three alternative treatment systems to be considered are: (1) stabilization pond, (2) aerated lagoon-irrigation and (3) ridge and furrow. All three systems require land at least one-fourth mile from the dairy plant and other residences. As many as 60 dairy plants in Minnesota may be required to construct a waste treatment or disposal system. If this is true, estimated total investment would be from 1.2 to 2.6 million dollars, depending upon the type of waste treatment system used. These costs, as well as costs for updating municipal treatment systems, will inevitably be passed on to the consumer. (Merryman-East Central)

5353-A11, B3, C2, D3, E3, F1 EFFICACY OF BROILER LITTER SILAGE FOR BEEF STEERS

Department of Animal Science, Clemson University, Clemson, South Carolina 29631
D.L. Cross, G.C. Skelley, C.S. Thompson and B.F. Jenny
Journal of Animal Science, V. 47, No. 2, p. 544-551, Aug., 1978. 7 tab., 23 ref.

Keywords: Refeeding, Poultry litter, Cattle, Performance, Carcass quality, Waste composition, Economics, Ensiling

Eighty steers, representing two biological types were used in a randomized block to study the efficacy of broiler litter silage as a feed source. Broiler litter was ensiled separately from other feed ingredients in an oxygen-limiting structure at 35% moisture. Initially, all rations contained (dry matter basis) 30% concentrate plus (1) 70% corn silage (CS); (2) 60% CS and 10% broiler litter silage (BLS); (3) 40% CS and 30% BLS; (4) 20% CS and 50% BLS; (5) 70% BLS. Due to a low level of feed consumption and weight loss, the diet of steers receiving 70% BLS was changed after 35 days on test. For the entire study, steers in treatment 5 consumed 44% BLS and 56% corn (dry matter basis). Average daily gains were highest for steers receiving 30% BLS. Steers receiving 44% BLS and 56% corn were most efficient in converting feed to gain. Plasma and ruminal fluid metabolites were within normal physiological ranges. BLS feeding did not have a deleterious effect on beef carcass characteristics or organoleptic evaluation. Crossbred steers were more efficient in converting feed to gain than straightbred steers. Carcass grade, yield, marbling, backfat, percent kidney fat, and organoleptic evaluations for tenderness, flavor intensity and connective tissue were higher for straightbred than for crossbred steers. Least-cost estimates of feed costs per kilogram of gain were reduced by as much as 23% for a 300 kg steer receiving an upper limit of 30% of dietary dry matter from BLS. At this weight level, the least-cost program selected 70% CS and 30% BLS. (Cross-Clemson University)

5354-B2, D3, E3 PRODUCTION AND NUTRITIVE VALUE OF ARTHROSPIRA PLAT- ENSIS, A SPIRAL BLUE-GREEN

ALGA GROWN ON SWINE WASTES

Chief, Animal Industry Division, JCRR, 37 Nai Hai Rd., Taipei, Taiwan
P. Chung, W.G. Pond, J.M. Kingsbury, E.F. Walker, Jr., and I. Krook
Journal of Animal Science, V. 47, No. 2, p. 319-330, Aug., 1978. 5 fig., 6 tab., 38 ref.

Keywords: Swine wastes, Recycling, Algae, Chemical properties, Nitrogen, Carbon, Re-feeding

Methane generation has been proposed as a means of swine waste disposal. As a secondary treatment to recover nitrogen, carbon and other nutrients from the effluent of a methane generator, *Arthrospira platensis* (a blue-green alga also known as *Spirulina*) was grown and its nutritive value determined. This alga contained 55 to 61% crude protein and was easy to harvest. Three indoor culture ponds of .65 M² were designed and built. The ponds consisted of a bottomless wooden frame lined with a polyethylene sheet resting on a table top. Culture medium was kept circulating by a special aerator. An inorganic medium was evaluated. When algal growth reached a saturation point, there was still 70% of NO₃⁻ and 11% of HCO₃⁻ left unused in the medium. Swine waste fermented at a hydraulic retention time of 10 days gave the highest ration (2.3:1) of NH₃-N to TKN (about 70% NH₃-N). NH₃ seemed to support best the growth of algae, when the effluent was slowly infused. Organic acids in the effluent also provided a good source of carbon, a limiting factor when algae were intensively grown. Under the light intensity of 500 footcandles, *Arthrospira* yielded about 5g/M²/day. A sample containing 2,038 mg of NH₃-N produced 16,250 mg of dry algae, containing 9,750 mg protein or 1,560 mg N, giving an efficiency of nitrogen recovery of 76%. The protein of *Arthrospira platensis* showed a PER of 2.25, apparent nitrogen digestibility of 76.7% and biological value of 67.7%; no toxic effects were noted. (Chung-JCCR)

5355-A11, B1, E3 OBSERVATIONS ON THE USE OF ORGANIC FERTILIZERS IN IN- TENSIVE FISH FARMING AT THE GINOSAR STATION IN 1976

Intensive Fish Culture Station, Fisheries Department, Ginosar, Israel
U. Rappaport, S. Sarig, and Y. Bejerano
Bamidgeh, V. 29, No. 2, p. 57-70, 1977. 1 fig., 7 tab., 7 ref.

Keywords: Fish farming, Fertilizers, Animal wastes, Performance, Recycling

1. Observations were carried out on the effect of addition of various organic fertilizers in increasing yield, lowering FCR and cost of production of carp and tilapia under intensive mono-culture growth conditions. Chicken droppings, liquid cattle manure, corral manure and chemical fertilizer were used in these tests. 2. The results show that addition of fertilizer is largely effective during the summer months, less so in the fall and of no effect in the spring when the ponds will contain ample supplies of natural feed. 3. The best results were obtained by use of a solution of chicken droppings which increased the yield about 24% in comparison to the control, decreased the FCR by 0.8 units and lowered feed and fertilizer cost per kg fish by 52%. 4.

Corral manure produced poor and negative results, reducing the yield by 3%. 5. During the forthcoming year, it would be worthwhile to follow up various methods of fertilization using chicken droppings and compare the effect of dried chicken droppings with that of the same fertilizer in solution and also test the importance of frequency of application during the week. 6. Because of the great ease of chemical fertilization and possible testing of other methods of fertilization using chemical fertilizers such as application in liquid form and more frequent use. (Sarig-Fisheries Department)

5356-A8, B5, C2, E2 ROOT DEVELOPMENT IN DAIRY MANURE-TREATED SOIL

Z.F. Lund
Journal of Environmental Quality, V. 7, No. 4, p. 473-477, Oct.-Dec., 1978. 8 fig., 1 tab., 10 ref.

Keywords: Dairy wastes, Forages, Crop response, Fertilizers, Nitrogen, Phosphorus, Potassium, Waste composition

Effects of dairy cattle manure on root growth of two forage crops were evaluated in a rhizotron study. The four treatments consisted of mineral fertilizer mixed into or applied to surface soils; manure incorporated into surface soils at two rates: 70 and 140 metric tons/ha; and manure layered at 25-cm depth between the surface and subsoil at 140 metric tons/ha. Incorporation of manure promoted early root and top growth of pearl millet (*Pennisetum americanum* (L.) Leeke var. 'Gahi-1'). The increase in growth was attributed to increased soil temperature. The layered treatment acted as a barrier to gas movement and inhibited early root growth into the subsoil. Although lack of deep rooting reduced early top growth, millet eventually grew most rapidly on the layered treatment. Total dry matter yield on the layered treatment was equal to that from the 140 metric ton/ha incorporated treatment; lowest yield was on the mineral fertilizer treatment. Yield of fall-planted rye (*Secale cereale* L.) was nearly three times that of the mineral-fertilized plots. Root growth of rye was reduced with the high rate of incorporated manure. (Lund-USDA)

5357-B3, C1, C2, D3, E2 ANIMAL WASTE COMPOSTING WITH CARBONACEOUS MA- TERIAL

North Carolina State University, Raleigh, North Carolina 27607
W.S. Galler, C.B. Davey, W.L. Meyer, and D.S. Airan
Environmental Protection Agency Report EPA-600/2-78-154, Sept., 1978. 95 p. 27 fig., 25 tab., 56 ref.

Keywords: Composting, Land application, Crop response, Thermophilic, Waste storage, Temperature

High rate thermophilic composting of animal wastes with added carbonaceous waste materials followed by land application has considerable potential as a means of treatment and useful final disposal of these wastes. The process described in this report utilizes a

mechanically mixed, thoroughly aerated, thermophilic first stage in which the readily available carbonaceous materials are utilized by bacteria during the stabilization of the nitrogenous wastes. This is followed by a curing period in which the holocellulose is partially decomposed principally by fungi. The compost may then be added to soil. The testing of the compost's effect of plant growth was done in three phases. The first phase involved spreading the compost over grass as a top-dressing; the second was a greenhouse study using tomatoes, wheat, millet, and beans; while the third was a field test on tomato crops. In all three tests, the compost exhibited significant beneficial effects. The mulching experiment yielded increases in the dry weights of grasses of up to 57 percent over the control. The greenhouse experiments showed increases in dry weights of up to 400 percent for tomatoes and wheat over the control. Field studies, indicated that, both the tomato size and total yield over the growing season increased with increasing compost application. (Galler-North Carolina State University)

5358-A4, B1, F1 THE ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES ON THE FEEDLOTS INDUSTRY: LARGE SCALE SEGMENTS

Development Planning and Research Associates, Inc.
Environmental Protection Agency Report
EPA-230/2-78-008, Feb., 1978, 180 p.

Keywords: Economics, Feedlots, Effluent control, Water pollution control

Feedlots included in the study represent a small percentage of all feedlots but account for a significant portion of livestock and poultry marketings. Estimated after-tax return on sales range from 2 percent for cattle and layer operations to 7 percent for hog operations, with the majority of operations ranging between 2 and 5 percent. With the exception of dairymen, practically all producers are price-takers; dairymen do have some collective bargaining power. Imposition of effluent limitations is expected to impact primarily the large beef, hog, dairy and turkey operations. Beef, hog, and turkey prices are not expected to increase immediately because of a lack of bargaining power; milk prices, in the short-run, will increase less than one percent. In the long-run, price increases will be minor and should be between 1 and 1.5 percent. With effluent controls, most operations will still maintain positive net present values although major declines appear for 1,000 hd beef feedlots and both sizes of turkey feedlots evaluated. Cash flows were not seriously affected. Employment and community impacts will be slight as no closures of feedlots are projected to arise from implementation of controls. The impact analysis is based upon a number of assumptions and cost estimates which are identified. (Development Planning and Research Associates, Inc.)

5359-A11, B1, C3 TRANSMISSION OF SALMONELLA LA BETWEEN FEEDLOT CATTLE

N.A. Clinton
M.S. Thesis, Texas A&M University, Aug.,

1977, 62 p. 4 fig., 10 tab., 51 ref.

Keywords: Cattle, Bacteria, Salmonella, Animal health, Performance

Sixty percent of the cattle pens at eleven Texas feedlots were sampled for *Salmonella* species twice during the winter and spring of 1978. Ten different serotypes and three untypeable salmonellae were isolated in this survey. The salmonellae resulted from contamination from a wide variety of sources and congregation of cattle from many geographical areas. The two most common serotypes were *Salmonella anatum* and *Salmonella typhimurium*. Transmission of salmonellae was studied between cattle in two different experiments. In the first experiment cattle were penned together with 3 or 4 calves intentionally infected with *Salmonella typhimurium*. In the second experiment salmonella were established in the pens of the experimental feedlot, in order to determine if cattle could become infected with salmonella by being held in pens which previously contained infected cattle. In the first experiment, 17% of the calves became permanent carriers. Sixty percent of the cattle excreting *Salmonella typhimurium* did not develop or gain as they were expected to. In the second experiment in which 9 salmonella-free cattle entered pens which had housed at least 22 salmonella excreting calves, 5 of the animals became infected. (Merryman-East Central)

5360-A11, B3, E3 DRIED CATTLE WASTE TESTED IN SWINE RATIONS

Anonymous
Southern Hog Producer, V. 9, No. 5, p. 15, Oct., 1978.

Keywords: Refeeding, Cattle wastes, Swine, Performance

J.P. Hitchcock, D.F. Ellis and C.K. Bensinger of the University of Tennessee fed 126 pigs various amounts of calcium, phosphorus, lysine and vitamin-trace minerals with a standard basal ration and 10 or 20% of dried cattle waste product. The pigs gained as much as 1.6 pounds per day on the basal diet, which was 16% crude protein, fortified, corn-soybean meal-tankage ration. One pound of gain resulted from the two pig diets containing the 20% cattle waste product, while it took one pound of feed to produce .24 pound of gain in the 10% cattle waste plus corn-soybean meal and .77% lysine. (Little-East Central)

5361-B3, E3, F1 MANURE MARKET ACTIVE IN PA

Anonymous
Poultry Tribune, V. 84, No. 10, p. 6, 8, Oct., 1978.

Keywords: Poultry wastes, Recycling, Economics, Refeeding, Fertilizer

According to Herbert C. Jordan, an extension specialist in poultry science, there is heavy trading in poultry manure in Pennsylvania. Local crop farmers are paying \$5 to \$10 per ton for fresh manure, \$10 to \$20 for dry manure (30% moisture) and \$40 to \$195 per ton bulk for dried poultry manure with 9 to 25% moisture. It is estimated that 50% of all

manure in Pennsylvania is used on local corn ground; 30% is sold to nearby dairy-crop farmers; 10% is sold to mushroom plants; and 10% is sold as feed supplement. (Little-East Central)

5362-B3, C2, D3, E3 A BATCH PROCESS FOR FERMENTATIVE CONVERSION OF FEEDLOT WASTE FILTRATE (FLWF) INTO A RUMINANT FEED SUPPLEMENT

Department of Animal Husbandry, Michigan State University, East Lansing, Michigan
M. D. Erdman and C. A. Reddy
Research Report 353, Michigan State University Agricultural Experiment Station, Sept., 1978, p. 270-279, 6 fig., 2 ref.

Keywords: Refeeding, Feedlot wastes, Fermentation, Crude protein, Waste composition

Fermentation of FLWF, supplemented with a waste carbohydrate source such as cheese whey, for 24 hr by the indigenous microbial flora at 43°C and pH 5.5 (pH maintained constant by the automatic addition of ammonia) results in a product rich in crude protein (CP, TN x 6.25). At 3.5% lactose concentration, optimum rates of fermentation were observed at pH 7.0 and 7.5 and the fermentation was complete (% conversion of substrate to product was 90%) within 8 hr and the CP content of the product was 78% (dry basis). The rates of fermentation and CP content of the product decreased at lower pH; 4.5 < 5.0 < 5.5 < 6.0 < 6.5 and the fermentation did not go to completion after 24 hr at pH 4.5. About 70% of the CP in the product was in the form of non-protein nitrogen (NPN) and the remainder was microbial cells. After 8 hr of fermentation at pH 7.0, most of the NPN was in the form of ammonium lactate and ammonium acetate; but at the end of 24 hr ammonium propionate and ammonium butyrate were also present. Fermentation was optimal at 43°C, less so at 37°C and considerably inefficient at 23 and 50°C. Lactose concentrations from 3.5% to 8.5% were fermented efficiently. Fermentation of FLWF obtained from animals fed a low silage-high grain, high silage-low grain or dairy ration resulted in a similar product. (Erdman-Michigan State University)

5363-A11, B3, E3, F1 BROILER LITTER PERKS UP PASTURE GAINS

D. Deterling
Progressive Farmer, V. 93, No. 11, p. 36-37, Nov., 1978, 1 fig., 1 tab.

Keywords: Litters, Refeeding, Cattle, Performance, Economics

It is apparent that producers view broiler litter as a resource that, when used correctly can be a valuable component in an efficient, profitable livestock feeding program. Wayne Taylor, Texas A&M Extension economist, notes that livestock producers who have broiler litter available can winter cows, add weight to thin cows for slaughter, produce stockers that can go right into the feedlot, or add finish to

slaughter calves by supplementally feeding broiler litter. He adds that supplemental feeding of broiler litter also can improve livestock gains on perennial summer pasture. Wintering of cattle on a broiler litter supplement was successfully done by Wayne Boozer of Nacogdoches County, Texas. With 50% broiler supplemental feeding, Boozer was able to maintain a stocking rate of 2.66 steers per acre on wheat and ryegrass. Average daily gain from Oct. 20 until May 16 was 1.51 pounds per head. Pasture gains averaged 900 pounds per acre. Boozer estimated that cost of his grain litter ration was \$3.07 per hundred-weight (cwt). Average cost for feed and pasture was 24.7 cents per pound of gain. Total out-of-pocket costs averaged 35.3 cents per pound of gain. With gains averaging 338 pounds per head, return over variable costs totaled \$211.07 per acre and \$78.77 per head. Jim Bucklew, Jr., of Center, Texas and John Mettauer of Nacogdoches, Texas also report, the successful feeding of poultry litter supplements. It is suggested that cattle for slaughter be taken off the litter ration two weeks before marketing. (Merryman-East Central)

5364-A8, A11, B2, C2, E2 THE EFFECTS OF APPLYING PIG SLURRY CONTAINING HIGH LEVELS OF COPPER TO SHEEP PASTURES

W.A. Kneale, and P. Smith
Experimental Husbandry, V. 32, No. 1, p. 1-7, 1977. 2 fig., 5 tab., 10 ref.

Keywords: Land application, Swine wastes, Pastures, Sheep, Toxicity, Copper, Crop response, Animal health

From 1971-73 at Great House Experimental Husbandry Farm, experiments were carried out in which ewes and lambs grazed pasture which had received heavy dressings of pig slurry. Blood samples of the ewes were taken and analyses of blood copper levels and liver specific enzymes were used to monitor the copper status of the sheep. Grassland receiving wastes from swine fed a fattening ration containing 180 ppm of copper, was grazed by sheep the following spring and summer. The blood copper levels of the sheep were not elevated. However, liver biopsies taken from sheep grazing a field which received copper rich swine wastes throughout winter and summer revealed liver damage. Some of the sheep were close to death from poisoning. It was also found that high levels of swine slurry from an effluent treatment unit failed to elevate copper herbage levels. It appeared that chemical changes taking place in an anaerobic storage tank rendered the copper unavailable to herbage. (Little-East Central)

5365-B3, C2, E3 DIGESTIBILITY OF FEEDLOT WASTE

R.R. Johnson
Animal Sciences and Industry Research Reports, No. 87, p. 82-85, March, 1972. 5 tab.

Keywords: Feedlots, Livestock wastes, Re-feeding, Ash, Waste composition

The nutritive value of feedlot wastes as a

component of rations for ruminant animals was investigated. Material was collected at the Texas County Feedlot in Guymon, Oklahoma and The Ark Valley Feedlot, Arkansas City, Kansas. The feedlot wastes were included in rations at levels of 25 and 40%. The results of the experiment showed that all samples were very high in ash content varying from 35 to 43.5%. Crude protein content varied from 15 to 19% and acid detergent fiber varied from 25 to 40%. Digestibility of the dry matter varied from 35 to 50% and organic matter from 42 to 56%. The crude protein digestibility varied from 60 to 71%. Further studies will be conducted on the nutritive value of these feedlot wastes and on the economics of refeeding them. (Little-East Central)

5366-B2, C2, E2 EFFECT OF ENVIRONMENTAL FACTORS ON SURVIVAL OF *SALMONELLA TYPHIMURIUM* IN SOIL

Graduate Research Assistant, Agronomy Department, University of Missouri, Columbia Missouri 65201

L.M. Zibilake and R.W. Weaver
Journal of Environmental Quality, V. 7, No. 4, p. 593-597, Oct.-Dec., 1978. 6 tab., 18 ref.

Keywords: Pathogenic bacteria, Slurries, Cattle wastes, Survival time, Land application

Salmonellae have a wide host range that includes cattle and humans. Approximately 10% of the cattle excrete this microorganism in their manure. Most manure is ultimately disposed of on soil with little pretreatment. The survival times of salmonellae in soils varies greatly. This investigation was undertaken in the laboratory to determine how accurately salmonella survival can be predicted when environmental conditions are known. *Salmonella typhimurium* was inoculated into two Texas soils, a clay and a fine sandy loam, using cattle manure slurry and saline as inoculum carriers. Soil samples were incubated in the laboratory at three temperatures and moistures: 5, 22, and 39° C; and 0, 0.5, and 22 at tension, respectively. Survival was monitored for 12 weeks by direct spread plating of 1:10 dilution onto dulcitol-iron thiosulfate (DIT) medium developed for this experiment. The DIT medium restricted growth of normal soil microflora but allowed growth and differentiation of *S. typhimurium*. Statistical evaluation of treatment effects was complex because of three factor interactions. Soil moisture and temperature interacted as did soil moisture and inoculation method. Time as a factor strongly interacted with moisture, soil, and temperature. *S. typhimurium* died within 1 week in dry soil incubated at 39° C, interactions occurred that resulted in survival to 42 days. Survival at 5° and 22° C was comparable and usually longer than at 39° C. Salmonella populations increased on some samples at 3 days but declined afterward. (Zibilake-University of Missouri)

5367-A5, B2, B3, C2, E2 LEACHING OF CATIONS AND CHLORIDE FROM MANURE APPLIED TO AN IRRIGATED SOIL

Department of Soil and Environmental Science, University of California, Riverside, California 92521

P.F. Pratt

Journal of Environmental Quality, V. 7, No. 4, p. 513-516, Oct.-Dec., 1978. 3 fig., 15 ref.

Keywords: Leaching, Groundwater pollution, Dairy wastes, Land application, Cations, Chloride, Irrigation

Data for leached cations, (the sum of Ca^{2+} , Mg^{2+} , Na^+ , and K^+), and leached Cl and the ratio of cations to Cl leached from the root zone during a 4-year experiment with bovine manures on a Hanford soil are presented. Cation accumulation in the soil and the cations leached were linearly correlated with cation input. The removal of cations in harvested crops reached a maximum and then decreased as the input of cations increased. Leached Cl increased at a ratio of 1:1 with the Cl input in excess of removal in harvested crops, whereas leached cations increased with increase in inputs in excess of removal in crops and decreased with decrease in the volume of leachate. At low leachate volumes and with dry weights of liquid and solid manures at 21 and 40 metric tons/ha per year, respectively, the cations leached were less than in the check plots, indicating effective precipitation of the equivalent of the cations in the manure plus some of the cations in the irrigation water. At high leachate volumes manure increased the cations leached relative to the check treatment at all rates of manure. The dominant factor in cation leaching was volume of leachate. Carefully controlled irrigation to attain low leachate volumes combined with manure applications at reasonable rates could be used to reduce the overall effect of irrigation on the leaching of salts to ground waters. (Pratt-University of California)

5368-B2, C1, C2, D3, E3 PERFORMANCE AND RHEOLOGICAL CHARACTERISTICS OF A PILOT-PLANT ANAEROBIC DIGESTER TREATING BEEF MANURE

Iowa State University, Ames, Iowa
M.E. Hein, T.B. Greiner, and R.J. Smith
Paper No. MC-78-903, American Society of Agricultural Engineers, 1978 Mid-Central Meeting, St. Joseph, Missouri, April 7-8, 1978, 24 p. 11 fig., 2 tab., 17 ref.

Keywords: Anaerobic, Digesters, Cattle wastes, Rheology, Design, Mixing, Waste composition, Temperature, Methane

Rheological characteristics of beef manure and digester effluent can be evaluated using a rotating-bob viscometer (Chen and Hashimoto, 1976a). Use of a rotating cup may give different results. Digester effluent behaves in a nearly Newtonian manner. It may be considered Newtonian in design of agitation and heat exchange equipment. Suspension of solids, plugging, fouling of surfaces, and crust formations are problems to be considered in conjunction with the rheological characteristics. Diluted beef manure to the digester will behave either as a power law fluid or a Newtonian fluid, depending on the quantity of water added. The preceding problems of coarse solids plus ongoing biological degradation must be considered when assessing the effective flow characteristics of beef manure. The viscosity of influent and effluent decreases at higher temperatures. The effluent viscosity decreases linearly between 5° and 55° C. (Hein-Iowa State University)

5369-A6, A8, B2, C1, C2, D3
ARTIFICIAL MARSHES AS A
MEANS OF TREATING SWINE
MANURE: A PRELIMINARY
STUDY USING MODEL MARSH-
ES ESTABLISHED IN 1.2 m x 2.4
m BOXES

Botany and Plant Pathology Department, Iowa State University, Ames, Iowa
 A. van der Valk, D. Werblan, R.J. Smith, and M.E. Hein
 Paper No. MC-78-904, American Society of Agricultural Engineers, 1978 Mid-Central Meeting, St. Joseph, Missouri, April 7-8, 1978, 16 p. 3 fig., 6 tab., 8 ref.

Keywords: Swine wastes, Land application, Waste treatment, Marshes, Waste composition, Chemical oxygen demand, Kjeldahl nitrogen, Ammonia, Phosphates, Lagoons, Odor

Artificially propagated marshes were established with pure stands of 3 emergent aquatic plants native to Iowa. The marshes were loaded with swine manure and simultaneously flushed with recycled liquid from an overflow pit. Growth of all species was very good during the study (Aug. to first major freeze in Nov.). Significant reduction in TVS and COD were recorded, reductions in total N and P were only about 17%. (van der Valk-Iowa State University)

5370-B1, C2, E3, F1
ENERGY COST INCREASES
COULD MAKE POULTRY WASTE
MORE ATTRACTIVE FOR FUEL
THAN FEED

Feedstuffs Southeastern Correspondent
 R.H. Brown
 Feedstuffs, V. 50, No. 42, p. 4, 26, Oct. 9, 1978.

Keywords: Recycling, Refeeding, Methane, Fertilizers, Economics

Methods of recycling poultry wastes are examined. The cost of energy is retarding the dehydration of manure for refeeding purposes. Consequently, more interest is being taken in recycling poultry wastes as an energy source. Dr. Dennis D. Schulte of the University of Nebraska's agricultural engineering department states that recent research at Massachusetts showed that by converting the droppings to liquid manure and using the gas from an 80,000 flock, an operator could probably break even financially. Other energy recycling research is also cited. Even with a system producing the gas, there will still remain the problem of manure disposal. After the gas is made, manure will remain and will need to be put on land in the conventional manner. Considered from the aspect of recycling manure as fertilizer, the United States produces 6.7 million tons of poultry waste a year and in it are 250,000 tons of nitrogen worth approximately \$75 million. There is a market for such manure as a horticultural fertilizer. (Merryman-East Central)

5371-B2, E3
USABLE BIO-GAS FROM DI-
GESTER

Anonymous
 Poultry Tribune, V. 84, No. 10, p. 6, Oct., 1978.

Keywords: Recycling, Biogas, Poultry wastes, Swine wastes, Dairy wastes

Research findings of Dr. Ed Fulton at Tarleton State University indicate that gas production from poultry wastes may prove feasible on a poultry operation of 50,000 birds or more or a medium sized dairy or swine operation. (Merryman-East Central)

5372-B3, F1
TEXAS ENGINEERS COMPARE
MANURE COLLECTION METH-
ODS

Anonymous
 Feedstuffs, V. 50, No. 44, p. 12, Oct. 23, 1978.

Keywords: Waste collection, Feedlot wastes, Economics, Energy

Time-motion analyses were conducted at the Texas Agriculture Experiment Station to compare machine productivity, energy consumption, and cost of elevating scraper, wheel loader and wheel plus plowing or rototilling collection systems. A maximum manure collection rate of 176 tons/hour was obtained with the wheel loader/chisel plow combination, followed by 126 tons with the elevating scraper, 118 tons with the wheel loader and 117 tons with the wheel loader-rototiller. Assuming 100% efficiency, the most energy efficient system was the elevating scraper, at 1.07 hp hours per ton. Plowing or rototilling the manure pack before wheel loader collection reduced energy consumption 30% at 1.17 and 1.2 hp.-hr./ton, as compared to collection with only the wheel loader at 1.56 hp.-hr./ton. Manure collection costs were similar for the 4 systems averaging 19 cents per ton at 100% operation efficiency. Cost of loading feedlot manure ranged from 8-14 cents per ton, and averaged 11 cents per ton. (Merryman-East Central)

5373-A9, A10, B1, D2, D3
FLY PROBLEMS OCCUR IF WET
MANURE REMAINS

Anonymous
 Poultry Digest, V. 37, No. 441, p. 594, Nov., 1978.

Keywords: Fly control, Pesticides, Predators

Fly problems occurring in Massachusetts poultry houses result from manure that is too wet, cable cleaners that don't clean, and spray programs that are ineffective. Fly predators, both the Histerid beetle and Macrocheleid mite, work very well where conditions provide the right environment, namely, dry manure cleaned infrequently. Farms with fly predators must manage their manure removal carefully to maintain an effective population. Otherwise, they have to resort to pesticides. (Merryman-East Central)

5374-B3, D1, D3, E3
TIPS ON FEEDING BROILER LI-
TTER

Anonymous
 Progressive Farmer, V. 93, No. 11, p. 37, Nov., 1978.

Keywords: Refeeding, Poultry litter, Waste treatment

Advice for the feeding of broiler litter includes the following: (1) Use litter on which at least 3 batches of chickens have been produced to ensure adequate protein content. (2) Process litter properly. If ensiling, add water to raise moisture content to around 35%. Litter in airtight storage should be held for a minimum of 6 weeks before feeding. Litter stacked on the ground should have a depth of 6-8 feet and does not require additional moisture. A 4- to 6-mil polyethylene sheet should be used to form a moisture barrier between the ground and the stack. If uncovered, the outer crust should not be used as feed. (3) Run a periodic feed analysis on litter. (4) Mix litter well with grain. (5) Select the right type of cattle for your feeding program. (6) Don't start with calves that are too light. Stick with calves that weigh no less than 350 to 400 pounds. (7) Condition calves, work them, and put them on a starter ration before putting them on litter ration. (8) Don't try to push calves higher than 850 to 900 pounds. Rate of gain and feed efficiency drop sharply at heavier weights. (9) Line up a market in advance. Put cattle on a short grain-feeding period of 30 to 45 days to bring them up to grade and to head off any buyer or consumer resistance. (10) Cattle destined for slaughter should be taken off litter rations at least 2 weeks before delivery. (Merryman-East Central)

5375-B2, C1, D1, D3
THEY FOUND PUMP EMPTIES
PIT FAST

P. Queck
 Wallace Farmer, V. 103, No. 19, p. 13, Oct. 14, 1978. 1 fig.

Keywords: Pumping, Waste management

A nonvacuum tank and a pit pump can be purchased for almost the same price as a vacuum tank. Advantages of the nonvacuum tank and pit pump are: (1) Tanks can be filled faster. (2) The pump can be used to agitate the pit, resulting in a more uniform consistency for spreading. Good agitation aids in getting solids out of pits. Vacuum tanks often have trouble sucking up the thick sludge which accumulates in pit bottoms. Commercially available bacteria may also be used to liquefy manure. (Merryman-East Central)

5376-B1
SLATTED FLOORS ARE START-
ING TO MIX WITH BEDDING

J. Byrnes
 Hog Farm Management, V. 15, No. 11, p. 20-22, Nov., 1978. 2 fig.

Keywords: Floors, Bedding, Swine wastes, Slatted floors, Lagoons

Lynn Cole of Mt. Blanchard, Ohio is pioneering a new waste management method. Mr. Cole utilizes three modified-open-front sheds for his swine. These offer the traditional advantages of natural ventilation, mechanized feeding and partial slat floors. The sheds also

utilize corn cob bedding which has been dried and ground to a uniform #2 size. It is felt that this bedding may provide an alternative to using zone heating. The cobs cost about \$57/ton and Cole uses about 2 tons/month in his three buildings. An auger box mounted on a skid steer loader augers the cobs to the bedded area through a chute in the back of the pens. The pens are never cleaned and the cobs gradually work their way into the pit. The barn cleaners from each of the modified-open front buildings feed into a central cross conveyor. That cross conveyor dumps into a pump that pushes manure into a 12-in. sewage pipe that goes to an outside lagoon. The weak point of the system has been the number of mechanical contrivances needed to move the manure. However, it is hoped that the better performance will pay for the extra mechanized parts. It is not yet known how difficult the corn cob manure will be to remove from the outside lagoon. (Merryman-East Central)

5377-A9, A10, B1, D2, D3 MANAGEMENT OF BEETLES FOR FLIES IN PIT HOUSES

Anonymous
Poultry Digest, V. 37, No. 441, p. 483, Nov., 1978

Keywords: Fly control, Predators, Beetles, Mites, Insecticides

While beetles may be beneficial in controlling flies, they can also create problems. They may burrow into insulation and lumber to pupate and they sometimes migrate to a ranch manager's nearby home. When pit houses are cleaned, most of the beetles will be removed. When fresh manure falls to the ground, it receives very little of the drying effect necessary for the survival of the beetles. Consequently, flies can become a very severe problem at this time. When the flies are sprayed, this usually kills the remaining beetles on the ground. Then it takes a very long time to reestablish the predator population. In such cases, it is recommended that dry manure containing beetles be spread in the houses. A trial is cited in which Rabon wettable powder was sprayed in a pit house in order to control the beetle population which had become a nuisance. A six-month control of the population was achieved. (Merryman-East Central)

5378-B1, E3 MANURE-TO-METHANE AT CALIFORNIA FEEDLOT

Anonymous
Compost Science, V. 19, No. 5, p. 2, Sept.-Oct., 1978, 1 fig.

Keywords: Recycling, Methane, Refeeding

The Pacific Gas and Electric Company and the Southern California Gas Company are building California's first manure-to-methane test facility at a cattle feedlot near Brawley, California. Bio-Gas of Colorado, Inc., designed, built and operated the facility, which will convert one ton of manure from 75 to 100 head of cattle daily to 7,000 cubic feet of natural gas. The University of California will be performing cattle feeding trials utilizing a high-protein feed which will be derived from this process. Expansion of the demonstration project into commercial-size plants capable of processing manure from 50,000 to 400,000

head of cattle is envisioned. Preliminary investigations have shown that about 30 million cubic feet of methane daily can potentially be produced from feedlot waste throughout California. (Merryman-East Central)

5379-A12, B1, C2 MANURE GASES CAN BE LE- THAL

Anonymous
Wallace Farmer, V. 103, No. 21, p. 14, Nov. 11, 1978.

Keywords: Gases, Toxicity, Ammonia, Methane, Carbon dioxide, Hydrogen sulfide, Safety, Public health

Toxic gases such as ammonia, methane, carbon dioxide, and hydrogen sulfide are released by decomposing livestock manure. Concentrations as low as 10-15 parts per million can cause headaches, irritation of the respiratory tract and mucous membranes, nausea and dizziness. Concentrations above 1000 parts per million can cause fainting and even death. Precautions that should be taken include: (1) Equate ventilation with exhaust fans. (2) Obtain a standby generator if a power outage could have dangerous consequences. (3) When agitating manure, open doors and windows of the confinement building and turn out livestock and stay out of the building. (4) If a manure pit must be entered, a self-contained breathing device and a safety harness should be used and a co-worker should be posted outside the pit to keep watch on things and to help out in case of trouble. (Merryman-East Central)

5380-A11, B3, D1, E3 BROILER LITTER SUITABLE FOR WINTERING COWS

Anonymous
Poultry Digest, V. 37, No. 441, p. 595, Nov., 1978.

Keywords: Poultry litter, Refeeding, Cattle, Performance

Research has demonstrated that mixtures of broiler litter and grain can adequately supply cattle's nutritional requirements without a drop in productivity and performance. Probably the best and most practical use of broiler litter in East Texas is to winter cows. Stocker calves and replacement heifers may be wintered on broiler litter rations that contain more grain. Maintenance rations may be provided with 75% broiler litter and 25% grain mixtures. Excellent growth can be obtained with 50% broiler litter and 50% grain mixtures. A mixture of 80% broiler litter and 20% ground corn and milo provides an adequate ration for the brood cow. Dry cows may be fed at the rate of 15 or 16 pounds of the mixture per head daily plus three pounds of hay. Lactating cows need 20 to 25 pounds of the mixture daily plus 4 pounds of hay. The broiler litter should be run through a hammer mill that has a magnet to remove metal particles. (Merryman-East Central)

5381-A6, B1, C2, D2

FEED ADDITIVE MASKS MA- NURE ODOR

Anonymous
Poultry Digest, V. 37, No. 440, p. 512, Oct., 1978.

Keywords: Odor control, Poultry wastes, Feed additives, Ammonia

When an odor suppressant (H&D Brand) was fed to caged White Leghorn hens, hen house odors from stored manure were reduced. Levels of the additive ranged from 12.3 parts per million to 44.8 parts per million in the feed. Panelists found no significant differences in the odors of the manure from birds fed various levels of the additive, but all the samples were less objectionable than the manure from the control group. Apparently, the product masked the odor, because the ammonia level was no different among the various treatments. (Merryman-East Central)

5382-B2, D1, D3 A MATHEMATICAL MODEL OF A PIG SLURRY TREATMENT SYSTEM

Systems Department, N.I.A.E., Wreast Park, Silsoe, Bedford, England
E. Audsley, D.S. Boyce, J.A. Wheeler, and A.G. Dumont
Journal of Agricultural Engineering Research, V. 22, No. 4, p. 421-437, Dec., 1977, 5 fig., 3 tab., 11 ref.

Keywords: Model studies, Mathematical models, Swine wastes, Slurries, Separation techniques, Filtration, Design

Mathematical models have been developed of a pig slurry treatment system which includes mechanical separation of the fibre from the raw slurry, treatment of the defibred slurry in a biological filtration tower and then a further separation of sludge. Both the fibre and sludge are handled as stackable solids. Evaporation is considered to take place from the slurry within the pig house, within the filtration tower and from the defibred slurry which is being dehydrated. The models are suitable for considering both steady and variable inputs of raw slurry and evaporation. This study indicates many of the problems likely to be encountered when designing and operating such a system. In particular it has been shown that only small reductions in the dry matter content of the raw slurry can result in very large increases in the amount of liquid to be handled. (Audsley-N.I.A.E.)

5383-B2, B3, C2, D3, E3, F1 CALIFORNIA GAS UTILITIES LOOK TO MANURE

Anonymous
Calf News, V. 18, No. 12, p. 22, 35, Dec., 1978, 3 fig.

Keywords: Recycling, Methane, Cattle wastes, Feedlots, Economics, Refeeding, Cattle, Sheep, Solar energy

Feedlot manure and the impending shortage of natural gas prompted Southern California Gas and Pacific Gas & Electric Co. to establish a test facility for producing methane gas.

Bio-Gas of Colorado, now with 5 years experience, designed California's Imperial Valley which was dedicated October 25, 1978. The facility is designed to process manure from 100 head of cattle to produce 7,000 cu. ft. of methane daily. This output will be used by the Kershaw mill for their broiler. The residue from the anaerobic process (in which bacteria in the absence of oxygen kept at proper temperatures produce the gas) will be sun dried on a concrete slab and fed to cattle at the University of California's Meloland research station. The residue may also have value as a feed supplement for sheep. The plant cost approximately \$300,000. A solar energy system, which was incorporated into the plant to supply heat for the 2 large digesters, makes the economics of production even more attractive. (Merryman-East Central)

5384-A11, B1, D3, E3 CHICKEN MANURE AIN'T HAY, BUT IT IS FEED

Anonymous
Compost Science, V. 19, No. 5, p. 2, 5,
Sept.-Oct., 1978.

Keywords: Poultry wastes, Refeeding, Cattle, Performance

In a study at the University of Minnesota Northwest Experiment Station, equal amounts by weight of pure chicken manure from caged birds and sunflower hulls were mixed and ensiled in an oxygen limiting structure. The ensiled mixture, 58 percent dry matter, was fed following a 3-week fermentation period to Holstein steers. Steers fed this mixture gained 2.03 pounds daily. Steers fed alfalfa haylage gained 2.29 pounds daily. Carcass quality of the two groups was the same. (Merryman-East Central)

5385-A6, A8, B2, C1, C2, D3 TREATMENT OF WASTE FROM A CONFINED HOG FEEDING UNIT BY USING ARTIFICIAL MARSHES

Department of Botany, Iowa State University, Ames, Iowa 50011
D. Werblan, R.J. Smith, A.G. van der Valk, and C.B. Davis
Proceedings, International Symposium on Land Treatment of Wastewater, V. 2, Corps of Engineers, Cold Regions Research & Engineering Laboratory, Hanover, New Hampshire, 1978, p. 149-155, 1 fig., 4 tab., 5 ref.

Keywords: Waste treatment, Swine wastes, Marshes, Soil-water-plant relationships, Design, Chemical oxygen demand, Nitrogen, Phosphorus, Solids, Odor control

A 1-year study has been completed to evaluate use of artificial marshes as a treatment system for waste from confined hog feeding operations. A 3 x 3 factorial experimental design was employed to evaluate the performance of marshes planted with one of three emergent species (*Sperganium eurycarpum*, *Phragmites australis*, *Typha glauca*) and receiving three different loadings of hog waste. Each treatment was replicated twice. For each marsh, a complete hydrological and nutrient (N,P) budget was determined. Data on COD and solids were also collected. The growth of the

plants, particularly rates of vegetative reproductions, were also monitored regularly throughout the growing season to examine the effect of sludge accumulation on plant vigor. Because the odor associated with present animal waste handling systems has been a major problem, the most important feature of artificial marshes treating hog waste is that they seem not to have developed any odors during their first year of operation. Emergent plants have a system of internal air spaces that allows oxygen from the leaves to diffuse into the rhizomes and roots. Enough oxygen seems to be diffusing out of the roots and into the accumulating sludge to prevent it from becoming completely anaerobic. (Werblan-Iowa State University)

5386-B2, C1, C2, D3, E2, E3, F1 THERMOPHILIC, ANAEROBIC FERMENTATION OF BEEF CAT- TLE RESIDUE

U.S. Meat Animal Research Center, Science and Education Administration, U.S. Department of Agriculture, Clay Center, Nebraska 68633

A.G. Hashimoto, Y.R. Chen and R.L. Prior
Institute of Gas Technology's Conference on Energy from Biomass and Waste, Washington, D.C., Aug. 14-17, 1978, 24 p. 5 fig., 11 tab., 13 ref.

Keywords: Cattle wastes, Fermentation, Anaerobic, Methane, Refeeding, Proteins, Economics, Design, Waste composition, Slurries, Drying, Land application, Recycling

This report summarizes the research being conducted at the U.S. Meat Animal Research Center to convert livestock manure into methane and a high protein feed ingredient by thermophilic anaerobic fermentation. The pilot-scale fermentor is 5.7 m with a working volume of 5.1 or 5.4 m depending on the retention time. The fermentor was operated at 55°C; and 20, 12, 6 and 4 days' retention times at loading rates of 314, 5.2, 11.4 and 15 kg VS/m³/day, respectively. The results showed that the total solids, volatile solids and COD reduction decreased as the retention time decreased; the fixed solids and total nitrogen were not lost during fermentation; and the total gas and methane production rate increased as the retention time decreased. High protein biomass from the fermentation was recovered through centrifugation and by direct incorporation into the ration. Amino acids analysis showed that the fermentor effluent compared favorably with soybeans and that the centrifuged cake compared favorably with alfalfa hay. Feeding trials using dried centrifuge cake showed that the digestibility of dry matter, organic matter, and nitrogen tended to decrease slightly as the amount of centrifuge cake in the ration increased. The greatest change was in the ash digestibility, which decreased from 59.5% in the control to 28.4% in the ration containing 20% cake. A feeding trial using fermentor effluent mixed with corn and hay showed that the fermentor effluent can be substituted for soybean meal without affecting animal performance. An economic assessment was performed on a hypothetical, thermophilic, anaerobic fermentation system for a 10,000-head beef feedlot. The assessment showed that the capitalized investment costs ranged from \$85 to \$131/head, and the annual costs ranged from \$29 to \$39/head/yr, depending on the type of biomass recovery system used. The value of the total energy production was \$13.80/head/yr, while the net energy production was \$7.65/head/yr at the current interstate price of natural gas. The value of

the protein in the fermentor effluent was calculated to \$82.90/head/yr. The value of the protein recoverable by centrifugation ranged from \$14.50 to \$41.50/head/yr depending upon the capture efficiency of the centrifuge. By combining the values of the protein and energy produced by the system, it is obvious that the proposed thermophilic anaerobic fermentation system is economically feasible. (Hashimoto-USDA)

5387-A2, B2, C2, C3 FEEDLOT RUNOFF AND SEW- AGE EFFLUENT AS POTENTIAL WATER POLLUTION WITH EM- PHASIS ON NITROGEN AND PHOSPHATE LEVELS AND OXY- GEN DEPLETION

Department of Chemistry, New Mexico State University, Las Cruces, New Mexico 88003
D.K. Brandvold and J.A. Brierley
WRRI Report No. 090, Technical Completion Report, Project No. A-054-NMEX, New Mexico Water Resources Research Institute, Nov., 1977, 20 p. 6 tab., 9 ref.

Keywords: Feedlot runoff, Sewage, Water pollution, Nitrogen, Phosphates, Oxygen depletion, Bacteria, Biochemical oxygen demand

The effects of the input from a small sewage plant and a feedlot on a small drainage ditch were investigated. Primary parameters used in the study were bacterial numbers and type, chemical forms of nitrogen, phosphate and dissolved oxygen. Originally, it was planned to use chemical assays and bacterial typing to identify the source of various pollutants. Success was partial. It was found that the feedlot contributed both Kjeldahl nitrogen and nitrate to the drain. No phosphate contribution was detected. Oxygen levels were unaffected by the feedlot except after storm runoff. The feedlot runoff after heavy rainfall was very high in nitrate, Kjeldahl nitrogen, phosphate and BOD. During the dry time of the year, significant amounts of ammonia were released. Microbial studies were difficult to assess due to high levels associated with agricultural drains. These drains also interfered with chemical studies because of high background levels of pollutants. (Brandvold-New Mexico State University)

5388-A12, B2, C1, C2, C3, D3, E3, F1 THE COMPLEAT BIOGAS HAND- BOOK

D. House
The Compleat Biogas Handbook, At Home Everywhere, 1978, 403 p.

Keywords: Recycling, Methane, Waste composition, Substrates, Design, Safety, Economics

This book is divided into 9 major sections - Overview, Parameters, Substrates, Uses, Troubleshooting, Design, Plans, Appendices, and On Saving the World. The book is written in an almost conversational manner, yet it relates valuable technical facts concerning biogas production. There are more than 50 charts, graphs and lists on all aspects of

biogas generation and use. Designs for six generators are included. Facts are presented about using biogas for illumination, cooking, waterheating, refrigeration, space heating, and methane powered vehicles. There is a chapter on the agricultural use of effluent. In addition to the book's information concerning biogas production, the book is also used as a vehicle for promoting the Bahai faith. (Merryman-East Central)

5389-B2, D3, E3 ENERGY RECOVERY FROM MANURE USING PLUG-FLOW DIGESTERS

Sheaffer & Roland, Inc., 130 North Franklin Street, Chicago, Illinois 60606
J.H. Martin and G. Dale
Paper No. 78-4568, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 7 p.

Keywords: Anaerobic, Digesters, Cattle wastes, Plug-flow, Methane, Recycling, pH, Temperature, Volatile solids

Two anaerobic digesters have been treating cow manure in Michigan and in Wisconsin for a few years. Both of them employ plug-flow, contrasted with stirred-pot, management of the manure and operate at mesophilic temperatures. They exhibit very high stability and good methane yield at feeding rates in excess of 10 kg of volatile solids per day per cubic meter of digester volume (0.8 lb/ft³/day). Dispersion occurs in the velocity of the material passing through the digester so that large pieces pass much more slowly than the hydraulic velocity. Odors in the effluent disappear when hydraulic detention times are as long as 4 days. From measurements of energy content, the biogas is about 60 percent methane. The pH of the digester is between 7.0 and 7.2 under most steady feeding conditions. Under transient feeding conditions it may range from 6.8 to 7.8. (Martin-Sheaffer & Roland, Inc.)

5390-A11, B3, D3, E3 MANURE -- ANIMAL FOOD OF THE FUTURE

Anonymous
Poultry Tribune, V. 84, No. 10, p. 21, Oct., 1978.

Keywords: Poultry wastes, Refeeding, Cattle, Ensilage, Performance, Meat quality

A University of Minnesota experiment was conducted in which equal amounts by weight of pure chicken manure from caged birds and sunflower hulls were mixed and ensiled in an oxygen limiting structure. The ensiled mixture, 58% dry matter, was fed following a three-week fermentation period to Holstein steers. Control animals were fed alfalfa haylage with both groups receiving 10 pounds of ground barley daily per animal. Animals fed the chicken manure-sunflower hulls mixture gained 2.03 pounds daily. Those fed alfalfa haylage gained 2.29 pounds daily. Carcass quality of the 2 groups was the same. (Merryman-East Central)

5391-B2, C2, D3, E3, F1

HAMILTON STANDARD'S RECYCLING PLANT NOW ON STREAM

Southeastern Editor, Calf News
D. Foster
Calf News, V. 17, No. 1, p. 6, 10, 28, Jan., 1979. 5 fig.

Keywords: Recycling, Methane, Refeeding, Reclamation, Dry Ice, Economics, Fermentation

About 150 people including cattlemen, scientists, government officials, media people and just interested people turned out for Don Kaplan's dedication for his manure conversion system on December 8, 1978. This system was sponsored by the Department of Energy and by Hamilton Standard. Kaplan says that his total confinement, environmentally balanced, slatted floor was the main reason for the sponsorship for Kaplan's facility which is the first large-scale test of such waste conversion. With the existing environmental controls, the manure can be harvested on a regular basis and placed in the digestion tanks in a fresh state. Once in the tanks bacteria literally eat the manure and their waste convert the manure into the methane gases. Once the bacteria themselves die their remains provide the basis of the high protein feed supplement. However, Kaplan is currently selling the solid materials to local people who are using it to add tilth to phosphate-mined lands. While Kaplan admits that commercial applications for the system are still in the future, he says that he believes costs can be brought into line to fit most any size operation. He estimates that start-up costs for the system, depending on the size and nature of the operation, could be in the neighborhood of \$100 for each initial head. Kaplan says that once the Department of Energy and Hamilton Standard have completed their tests and the system becomes his property, he has even greater plans for it, possibly even making dry ice from one other common by-product of the system, carbon dioxide. (Merryman-East Central)

5392-B2, D2, D3, E2, F1 WASTE TREATMENT - WHERE DOES IT FIT IN?

Scottish Farm Buildings Investigation Unit
A.M. Robertson
Farm Buildings Progress, V. 39, p. 19-24, Jan., 1975. 3 fig., 4 tab., 3 ref.

Keywords: Slurries, Waste treatment, Biological treatment, Chemical treatment, Waste storage, Odor control, Legal aspects, Swine wastes, Poultry wastes, Aerobic, Anaerobic

It is recognized that as much slurry as possible should be returned to the land in order to make the maximum use of nutrients contained in the slurry. Provided the method of collection, storage and spreading, and the application rates employed fall within recommended codes of practice, it is unlikely that treatment will be required as part of a slurry handling program. Where slurry in excess of the recommended carrying capacity of land available for spreading is produced, this excess may best be handled in a treatment system. Where spreading operations are likely to create a nuisance by virtue of the odours produced, aerobic treatment offers an economic solution to the problem. (Robertson-Scottish Farm Buildings Investigation Unit)

5393-A5, C2 NITROGEN IN THE SUBSURFACE ENVIRONMENT

East Central Oklahoma State University, Ada, Oklahoma 74820
M.L. Rowe and S. Stinnett
Environmental Protection Agency Report
EPA-660/3-75-030, June, 1975, 34 p. 106 ref.

Keywords: Nitrogen, Groundwater pollution, Leaching, Soil profile, Fertilizers, Animal wastes, Domestic wastes

Increased quantities of various forms of nitrogen are being released to the soil systems and higher concentrations of nitrogenous compounds are consequently making their way into subsoil regions. Knowledge of the behavior and fate of nitrogenous chemical species in the subsurface environment is needed by those concerned with the prevention and control of groundwater pollution. This paper presents information concerning the nature and origin of nitrogenous substances polluting groundwater, the probable movement and reaction of nitrogenous compounds in the subsurface environment, and specific cases of groundwater pollution by nitrogen-containing compounds. (Rowe-East Central)

5394-A11, B3, E3 BROILER LITTER IN FEED SUITS WINTERING COWS

Anonymous
Feedstuffs, V. 50, No. 53, p. 11, Dec. 25, 1978.

Keywords: Refeeding, Poultry litter, Cattle, Performance

Randall Grooms, Texas A&M University livestock specialist, says that one of the most practical uses of poultry litter in east Texas is for wintering cows. Brood cows may be fed a mixture of 80% broiler litter and 20% ground corn. Dry cows may be fed that mixture at the rate of 15-16 lb. per head daily with 3 lb. of hay, while lactating cows require 20-25 lb. of the mixture plus 4 lb. of hay. Stocker calves and replacement heifers may be winterized on poultry litter rations that contain more grain. Maintenance rations may be provided with 75% broiler litter and 25% grain mixtures. Excellent growth can be obtained with 50% broiler litter and 50% grain mixtures. Free choice salt should be made available. The broiler litter should run through a hammer that has a magnet to remove metal particles before use. (Merryman-East Central)

5395-A6 WASTE ODORS CUT BY ELIMINATING DUST PARTICLES

Anonymous
Feedstuffs, V. 50, No. 53, p. 9, Dec. 25, 1978.

Keywords: Odor control, Filters, Dust

Iowa State University food science researchers say that livestock waste odors are transported almost entirely on dust particles. They found that removing particulates from air discharged from or passing over livestock feeding facilities almost totally eliminated manure odor. (Merryman-East Central)

5396-B2, C1, C2, C3, D3, E3 PRODUCING METHANE GAS FROM SWINE MANURE IN A PILOT SIZE DIGESTER

U.S. Department of Agriculture, Agricultural Research Service, Columbia, Missouri
J.R. Fischer, E.L. Iannotti, J.H. Porter, A. Garcia

Paper No. MC77-604, American Society of Agricultural Engineers, 1977 Mid-Central Region Meeting, St. Joseph, Missouri, March 25-26, 1977, 12 p. 6 tab., 23 ref.

Keywords: Methane, Swine wastes, Digesters, Waste composition, Solids, Nitrogen, Chemical oxygen demand, Bacteria, Phosphorus, Potassium

A 0.42-m³ digester was operated for 1 year at a loading rate of 4 gm volatile solids/liter/day. Gas production was 2.2 m³ gas/m³ of digester liquid. The gas composition was 59 percent methane and 39 percent carbon dioxide. Fifty-two and sixty-one percent of the total and volatile solids were destroyed, respectively. Ammonia nitrogen concentration in the digester was approximately 3000 mg/liter. (Fischer-USDA)

5397-B2, C1, C2, D3, E3 UTILIZING THE ENERGY FROM A SWINE ANAEROBIC DIGESTER

Science & Education Administration, U.S. Department of Agriculture, University of Missouri, Columbia, Missouri 65211

J.R. Fischer, L. Christianson, and C.D. Fulhage
Paper Number MC-78-902, American Society of Agricultural Engineers, Mid-Central Regional Meeting, St. Joseph, Missouri, April 7-8, 1978, 15 p. 3 fig., 3 tab., 8 ref.

Keywords: Recycling, Methane, Digesters, Swine wastes, Energy consumption

Average mass production rate of methane from the digester is 54 grms/ha/SU (sow unit). Energy production from the digester varies according to the size and number of hogs in the system. Maximum energy produced is 950 watts/SU and the minimum is 506 watts/SU. These values correspond to electrical energy production of 150 and 80 watts/SU, respectively and thermal energy production of 570 and 310 watts/SU. Electrical energy consumption in the buildings for ventilation, lighting and consumption at the digester is normally about 71 watts/SU. Thermal energy requirements for the digester and buildings on an average January day are 560 watts/SU. Most of the electrical and thermal energy demands of the complex can be satisfied. (Fischer-USDA)

5398-A11, B3, E3 DRIED CATTLE WASTE EXPERIMENT CONDUCTED

Anonymous
Southern Hog Producer, V. 9, No. 6, p. 17, Dec., 1978

Keywords: Cattle wastes, Refeeding, Swine, Performance

University of Tennessee animal scientists fed 126 pigs 9 different rations in an effort to investigate the effects of various amounts of calcium, phosphorus, lysine and vitamin-trace minerals with a standard basal ration and 10 or 20% of dried cattle waste product. Treatments containing 10% cattle waste resulted in gains up to 1.6 pounds per pig per day and treatments containing 20% of the cattle waste gained about 1.4 pounds per pig per day. The two pigs diets with 20% cattle waste resulted in 1 pound of feed producing .23 pound of gain, while one ration that contained 10% cattle waste plus corn-soybean meal and .77% lysine took one pound of feed to produce .24 pound of gain. The pigs gained as much on the basal diet which was a 16% crude protein, fortified, corn soybean meal-tankage ration as they did on any other treatment. (Merryman-East Central)

5399-A12, B2, C2 BEWARE OF PIT GASES

Anonymous
Wallaces Farmer, V. 103, No. 20, p. 38, Oct. 28, 1978. 1 fig.

Keywords: Air pollution, Public health, Toxicity, Ammonia, Methane, Carbon dioxide, Hydrogen sulfide

Several Iowans die each year as a result of inhaling gases when cleaning buildings or entering emptied liquid manure tanks. Toxic gases such as ammonia, methane, carbon dioxide, and hydrogen sulfide are released from decomposing manure. Concentrations as low as 10 to 15 ppm can cause headaches, irritation of the respiratory tract and mucous membranes, and nausea. Concentrations over 1000 ppm can cause fainting and/or death. Precautions should be taken to keep gas concentrations as low as possible. (Merryman-East Central)

5400-B2, C1, C2, D3, E3 LOW TEMPERATURE ANAEROBIC DIGESTION OF SWINE MANURE

Betz Converse Murdoch Inc., Plymouth Meeting, Pennsylvania
M.A. Stevens and D.D. Schulte
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, V. 105, No. EE1, p. 33-42, Feb., 1979. 3 fig., 5 tab., 18 ref.

Keywords: Anaerobic digestion, Swine wastes, Design, Temperature, Recycling, Biogas, Chemical oxygen demand, Volatile solids, Waste composition

Anaerobic digestion of swine manure at low process temperatures was studied in two pilot-scale experiments where the effect of process temperature was evaluated in terms of biogas production, COD removal, and volatile solids destruction. The first experiment compared 25°C digestion with 35°C to 40°C digestion while the second experiment evaluated various solids retention times for digestion. Gas production rates were comparable to those reported in the literature for domestic sewage sludge digestion at low temperatures. In addition, the relative stability of low temperature digestion as measured by unionized volatile acid concentrations was good when compared to digestion at higher

temperatures. (Stevens-Betz Converse Murdoch Inc.)

5401-A4, A6, A7, A11, A12, B2, B3, B4, C1, C2, C3, D1, D2, D3, E2, E3, F2, F4 FARM WASTES HANDBOOK

A.M. Robertson
Farm Wastes Handbook, The Scottish Farm Buildings Investigation Unit, 1977, 114 p.

Keywords: Waste management, Water pollution, Odor, Legal aspects, Waste composition, Waste treatment, Recycling, Animal health, Public health, Waste storage, Land application, Incineration, Drying, Separation techniques, Biological treatment, Methane, Refeeding

This handbook was written with the purpose of providing information on farm waste management to advisors, farmers, building designers and others interested in the subject. The book begins with the agricultural situation and the problems that arise associated with waste management such as pollution of watercourses, production of odors, risks of disease spread, and the legislation affecting the handling and disposal of farm wastes. Emphasis is placed on the extreme variability of waste and the need to assess each situation with this in mind, calling on the expertise of the agricultural colleges and river boards where necessary. The available methods for treating and recycling wastes are described, from incineration to biological breakdown, but it is emphasized that waste should normally be utilized by returning it to the land. The last chapter deals with planning a waste management system. (Merryman-East Central)

5402-B1, C1, C2, C3, D1, D2, D3, E3, F1 ALTERNATE NITROGEN SOURCES FOR RUMINANTS

Tennessee Valley Authority
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, 90 p.

Keywords: Refeeding, Nitrogen, Cattle, Legal aspects, Waste composition, Waste treatment, Waste storage

This nonprotein nitrogen conference was organized to bring together the advancements in ruminant nutrition, to establish the extent of use of agricultural waste as a ruminant feed, and to assess the role of nonprotein nitrogen, particularly animal waste in further development of livestock and poultry enterprises in the region. The conference was jointly sponsored by TVA (Tennessee Valley Authority), land-grant universities in the Tennessee Valley States, and the Federal Extension Service. (Merryman-East Central)

5403-A11, B3, C1, C2, C3, D2, D3, E3 BROILER LITTER AS A FEED INGREDIENT FOR RUMINANTS

Virginia Polytechnic Institute and State University, Blacksburg, Virginia
J.P. Fontenot

Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 34-39. 4 tab., 32 ref.

Keywords: Poultry litter, Refeeding, Animal health, Cattle, Sheep, Copper toxicity, Waste composition, Protein, Nitrogen, Pathogenic bacteria, Insecticides, Drug residues, Chemical treatment, Heat treatment, Ensilage, Heavy metals, Trace minerals

It appears that broiler litter has substantial value for ruminants. It is high in crude protein, and the nitrogen is efficiently utilized by ruminants. The energy of poultry wastes also appears to be utilized efficiently by ruminants. The waste can be rendered free of pathogenic organisms by heat treatment or a combination of chemical and heat treatment. Deep stacking and ensiling are also effective in diminishing the risk of pathogens. Satisfactory performance has been obtained from feeding poultry litter. The amount of waste fed depends on the desired production level and the type of animal. Up to 80% litter can be used for wintering beef cows, but about 25% is probably the upper limit for fattening cattle. The only documented harmful effect on animal health from feeding poultry waste has been copper toxicity in sheep. It does not appear that this will be a problem in cattle, which are not as sensitive to high copper levels. It appears that pesticide residues in poultry wastes are not a serious problem. The medicinal drug residue problem in meat animals fed the waste does not appear to be serious. However, adequate withdrawal periods should be used. (Fontenot-VPISU)

5404-A11, C2, D1, D2, E3 CAGED LAYER WASTE IN RUMINANT NUTRITION

Mississippi State University, State College, Mississippi 39762
H.W. Essig

Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 40-44. 5 tab., 25 ref.

Keywords: Dried poultry wastes, Refeeding, Drying, Waste composition, Trace minerals, Heavy metals, Crude protein, Calcium, Phosphorus, Cattle, Performance

In most experiments in which DPW was used to supply a large portion of the crude protein in ruminants ration, gains were reduced and feed required to produce a kilogram of gain was increased. This inhibition of gains was due either to a lack of energy or some other unidentified influence on utilization. Therefore, it is necessary for continued investigation of reasons for reduced performance from feeding high levels of poultry waste to ruminants. (Essig-Mississippi State University)

5405-A11, C1, C2, C3, D3, E3, F1 CATTLE WASTE IN RUMINANT NUTRITION

Auburn University, Auburn, Alabama 36830
W.B. Anthony
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 45-48. 3 tab., 17 ref.

Keywords: Cattle wastes, Ensilage, Refeeding, Performance, Cattle, Carcass quality, Economics, Sheep, Crude protein

Continuing research at Auburn University has resulted in a move away from fractionating animal waste. Instead, animal waste is collected from the feeding pen, blended with other ingredients, and ensiled. In a recent Auburn experiment, forty-four steers were allotted by weight and breed to 4 treatment groups of 11 animals each. Group 1 served as the control; it received a basal ration containing 82.5% ground corn, 12% ground coastal bermudagrass hay, 4% liquid protein supplement, 1% calcium carbonate, and 0.5% trace mineralized salt. The experimental rations and groups assigned were: Group 2 - 80% basal and 20% wet manure, Group 3 - 60% basal and 40% wet manure, and Group 4 - 40% basal and 60% wet manure. The manure-containing mixtures were ensiled prior to feeding. At the beginning of the trial, all animals were implanted with 36 mg of RALGRO (Commercial Solvents). Zinc Bacitracin (70 mg/steer) and vitamin A (2200 I.U. per kg of ration dry matter) were topdressed on the feed daily. The cattle were fed for 112 days and slaughtered directly off test. Carcass information was collected and primal rib sections were taken for organoleptic evaluation. Study results confirmed that wet manure can be incorporated into a feed mixture, ensiled, and fed to finishing cattle without adversely affecting rate of gain or carcass quality, while reducing feed cost of animal gain. In all studies conducted at Auburn, carcasses from animals fed waste-containing feed mixtures have been fully comparable to carcasses from animals fed conventional rations. The major problems are associated with manure collection, feed blending, transport into and out of the silo, and ration formulation to meet specific animal needs. (Merryman-East Central)

5406-A11, A12, B3, C2, C3, D3, E3, F1 FERMENTED POULTRY WASTES FOR CATTLE

Clemson University, Clemson, South Carolina 29631

D.L. Cross
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 48-53. 4 tab., 32 ref.

Keywords: Poultry litter, Ensilage, Refeeding, Waste composition, pH, Lactic acid, Bacteria, Economics

Experimentation at Clemson University has led to the following recommendations for ensiling poultry litter: (1) Put water on litter in the poultry house. Bring moisture up to 35% to 40% moisture. (2) Allow water to soak litter for 8 to 12 hours. (3) Use scrape blade to pull litter to center alley. (4) Use front-end loader and dump in truck with dump bed. (5) Dump into silo and pack lightly with tractor. (6) Cover silo with plastic and cover plastic with tires. Throw dirt around edges of plastic. (7) Ensilage for at least 6 weeks before feeding. Feeding trials were conducted utilizing ensiled broiler litter. The trials revealed that feeding ensiled poultry litter to cattle will reduce feed costs. It will be especially useful for wintering brood cows since very high levels can be fed. It appears that feeding ensiled poultry litter does not present a health hazard. (Merryman-East Central)

5407-B3, B4, D3, E3, F1 DEEP STACKING BROILER LITTER AS A MEANS OF STORAGE FOR USE IN FEEDING BEEF COWS

Rocco, Inc.

R.H. Strickler

Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 56-57.

Keywords: Refeeding, Poultry litter, Cattle, Waste storage, Ensilage, Economics

Mr. Strickler relates incidents that he has experienced in relation to his refeeding of poultry litter to beef. After experiences with a number of kinds of storage, Mr. Strickler is presently storing litter in a large area with a roof over it. He has found it to be a cheap storage where spreader trucks can unload fast. The product is acceptable and the system is extremely flexible. Water, molasses, peanut hulls, vitamin A, and magnesium oxide can be added on the way into the silo so that a ready-to-feed ration is ready when the ensiled mixture comes out of the silo. Mr. Strickler believes that current economics make refeeding of poultry quite desirable. (Merryman-East Central)

5408-A11, B3, D3, E3 FEEDING CAGED LAYER WASTE TO BEEF CATTLE

Cedar Creek Poultry Farm

L. Parr

Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 57-58.

Keywords: Refeeding, Poultry wastes, Ensilage, Cattle, Performance

Larry Parr describes his feeding program which utilizes caged layer wastes as feed for beef cattle. Parr's feedlot is located in a wooded area with a good slope for drainage. The trees provide shade in summer and protection in winter. The lots are fenced with net wire with barbed wire at the top and cover about 3-4 acres. There are 150 to 200 steers per pen. There are fence line feed bunks 150 to 200 feet long in each pen. In addition to feeding caged layer waste, Parr raises feed corn silage. Parr stores the corn and waste silage in below ground pits with concrete bottoms. An ensilage loader and front-end loader are used to load the mixer truck. A tub grinder grinds the round bales of hay that are used in the reconstituted silage. The feedlot has room for 800 to 1,000 head at a time. The cattle are fed from about 700 lb. to slaughter. Waste silage, fed interchangeably with corn silage, is mixed with about 50% shelled corn. During the last 2-3 weeks, shelled corn is increased in the diet to market a better quality of beef. The cattle grade at about 80% choice, and yield from 60-62%. (Merryman-East Central)

5409-A11, B3, D3, E3, F1 FERMENTED CATTLE WASTE IN BEEF CATTLE RATIONS

Georgia Baptist Children's Home, Inc.
W. Baxter

Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 58-59.

Keywords: Cattle wastes, Refeeding, Cattle, Performance, Economics, Ensilage

Georgia Baptist's Children's Home, Inc. turned to feeding recycled manure as a means of cutting feed costs 15-20%. At their facility two sets of pens are connected by a feed alley. These are divided into 4 pens, giving a total of 8 pens with a feeding capacity of 400 cattle at a time. Cement-floor pits are 3 feet below slatted floors along the entire length of the feedlot. Recirculating scraper blades collect manure from the floors and it is augered into a small holding pit. From there the manure is pumped onto a mixer truck which has an Oswalt mixer and electronic scales. The truck moves to a storage area where cracked corn and roughage are mixed with the manure. Then the mixture is blown into an upright, sealed bottom load-out silo where it is ensiled for at least 10 days. When the feed is drawn from the silo into the Oswalt truck to be fed to the animals, enough soybean meal or commercial protein supplement is added to build the protein to about 12%. Total gain, from the beginning of the feedlot until now, has been approximately 2½ lb/day/animal. When the dirt feedlot has been utilized, cattle on the dirt lot (fed a commercial feed) gained about ¼ lb/day less than those on the slatted floors. The dirt lot cattle did not grade as well as the slatted floor cattle either. (Merryman-East Central)

5410-A11, B3, E3 USE OF DRY POULTRY WASTE IN BEEF CATTLE RATIONS -- WINTER FEEDING, GROWING AND FINISHING

F. Haley
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 60.

Keywords: Poultry wastes, Refeeding, Cattle, Performance

Fred Haley describes his current feeding program at Haley Farms. Haley removes his poultry wastes from the poultry house and loads it on a wagon which takes it to his mixer truck. The ingredients are weighed into the mixer truck. For cows on pasture, or brood cows, 75% broiler litter is mixed with 25% cornmeal and put in troughs in the pasture. Recently, steers have received a mixture of 50% corn silage and 50% poultry waste until 60 days before selling. At that time the silage was increased to 66.67% and poultry waste content was reduced to 33.33%. (Merryman-East Central)

5411-B3, C1, C2, D1, D2, E3 PROCESSING AND MARKETING CAGED LAYER WASTES AS RUMINANT FEEDS

Haley Farms
F. Haley
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 80-83. 1 fig.

Keywords: Poultry wastes, Refeeding, Cattle,

Drying, Design, Waste composition

Mr. Haley states that his farm has used 3 disposal systems — liquid manure, a series of lagoons, and mechanical drying. Mechanical drying is the system presently in use in the 40 by 400 feet semienvironmentally controlled poultry houses. The houses utilize exhaust fans, pit fans and tube fans to control the poultry house environment and to enhance the drying of the manure which is deposited into pits. The manure in the pits is plowed at 6-hour intervals during the day and once every 2 or 3 hours during the night. Manure is removed from the pits at 4- to 5-day intervals and taken to a dryer which is located a short distance to the rear of the 8 houses. Before entering the dryer, manure is run through a hammermill to fluff or tear apart some of the dryer lumps. Once the manure goes through the drying system, the dried manure is dropped into a 6-inch auger which carries the DPW to a bucket elevator which is discharged into one of four 12-ton overhead bins or one 8-ton bin used as a collector for sacking. The DPW is generally sold in bulk form or in bags rather than as a mixed feed. However, it has been sold in the form of range cubes, range meal, and steer rations containing DPW. Range meal, due to the ease of feeding, is the most requested mixed feed for the local market. An additional DPW product, a DPW protein block, will be available in north Mississippi beginning this fall. (Merryman-East Central)

5412-B3, E3, F1 LIVESTOCK AND POULTRY USE IN VIRGINIA

Virginia Polytechnic Institute and State University, Blacksburg, Virginia
H.J. Gerken, Jr.
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 66-67. 4 tab., 32 ref.

Keywords: Poultry litter, Refeeding, Cattle, Economics

Poultry litter was fed on 40 to 50 farms in Rockingham County, Virginia last winter. Short hay crops, high prices for grain and roughage, and low cattle prices were factors which prompted many cattle producers to try litter feeding for the first time. The situation this year is much the same and there is great interest in litter feeding in all poultry producing areas in Virginia. About 80% of the litter used for livestock feeding is processed by deep stacking before feeding. The remainder is ensiled alone or with corn forage. Most of the litter used is fed to beef cows. A typical ration would be a mixture of 80% litter and 20% ground shelled corn fed at the rate of 15 to 20 lb per head per day to dry cows and 20 to 25 lb per head per day to cows nursing calves. Litter has also been used in backgrounding programs, in cattle finishing programs, and in calf creep operations. Limited use of litter feeding is made with sheep due to concern for potential copper toxicity. Poultry wastes have not been accepted as feed for lactating dairy animals and producers should continue to observe this limitation. Under normal feed grain and roughage pricing situations, litter feeding will likely be restricted to close proximity to the poultry production area. However, transportation of litter for feeding purposes of up to 100 miles may continue to be economically sound. It appears likely that this feed resource will gain additional acceptance in the immediate future and will permit expansion of cattle numbers in those areas close to sources of supply. (Merryman-East Central)

5413-B3, B4, E3 PRACTICES, POTENTIALS, PROBLEMS, AND LIMITATIONS OF UTILIZING LIVESTOCK AND POULTRY WASTES AS A BEEF FEED IN GEORGIA

University of Georgia, Athens, Georgia 30601
M.K. Cook
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 67-68.

Keywords: Poultry wastes, Refeeding, Cattle, Waste storage

Poultry wastes can be used as a feed ingredient in beef cattle rations, but it must be recognized that the nutritional value of poultry wastes is variable and that feeding poultry waste can only meet a certain amount of the nutrient requirements. Storage and handling of the litter may present a problem to producers. Most producers are loose stacking litter in a shed or stacking outside, adding water and covering it with plastic. Those who are putting up silos and storing large quantities of litter are generally committing themselves to backgrounding and/or finishing cattle. Those producers who know what the litter will do and are using it to its best advantage are successfully using the materials. However, successful use dictates sound husbandry practices. (Merryman-East Central)

5414-B3, E3 FEEDING POULTRY WASTE IN TENNESSEE

University of Tennessee
H.C. Goan
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority, July, 1978, p. 68.

Keywords: Poultry litter, Refeeding, Cattle

For a broiler grower with one house, the potential to feed litter may be somewhat limited. However, a grower with several houses has enough litter to consider making additional investment to feed it to cattle. Egg producers with a high-rise, deep-pit type house can easily collect manure for a year and then mix it with hay, corn silage, or corn stover when available. The advent of feeding broiler litter may give rise to more cattle being fed by poultrymen that have never been in the cattle business. Feeding of poultry wastes has stimulated the need for more information on: (1) Value as a feed ingredient vs. fertilizer. (2) Additional equipment needed when feeding the poultry waste on a large scale. (3) Most economical method of storage. (4) Ration formulation to give the greatest returns. (5) Size and type of animal to feed for greatest returns. (Merryman-East Central)

5415-B3, E3 LIVESTOCK AND POULTRY WASTE USE IN MISSISSIPPI

Mississippi State University
J.C. Collins
Alternate Nitrogen Sources for Ruminants, Bulletin Y-130, Tennessee Valley Authority,

July, 1978, p. 69.

Keywords: Poultry litter, Refeeding, Cattle

The practice of feeding broiler litter to beef cattle in Mississippi is expanding each year. There is a potential supply of 600-700 pounds of poultry litter each year for cattle. Beef producers use deep stacked or ensiled broiler litter to supplement hay, silage, or grain rations for beef cows, replacement heifers and stocker steers, and heifers. In general, rations fed would be for: (1) Brood cows: (a) 75% to 80% ensiled litter plus 20% to 25% ground corn. (b) 5-6 lb of litter plus a full feed of silage of hay. (2) Replacement heifers and stockers: (a) 65% ensiled litter plus 35% ground corn. (b) 4-5 lb of litter, 4-5 lb of corn and full feed of silage or hay. In addition to broiler litter, one company in Mississippi produces a dried caged layer waste product which contains 30% protein and is used in rations very similar to methods in which plant proteins would be used. Problems in using poultry litter include: (1) There is a lack of uniformity in the litter. (2) Many types of foreign materials, such as glass, wire, metal objects, and rocks are found in some litter. (3) Many producers have found that 10% to 15% of the cattle adjust slowly to the feed of refuse to eat. (4) All beef producers do not produce broilers and all broiler producers do not produce cattle. (5) Most Mississippi producers have a small number of cows. Therefore, they cannot spend money for mechanization. Feeding will be done by hand. (Merryman-East Central)

5416-B3, C2, D3, E3 BROILER LITTER IN CATTLE FEED

Auburn University, Auburn, Alabama 36830
B.G. Ruffin
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 69-71. 2 tab.

Keywords: Poultry litter, Refeeding, Cattle,
Waste composition, Crude protein, Nitrogen,
Trace minerals, Ensilaging

Poultry litter and especially broiler litter is being stored and fed to beef cattle in increasing amounts. Most of the broiler litter being fed is to brood cows with some stocker-finishing programs being based on the use of litter. Brood cows are being fed enough corn mixed with broiler litter to meet their minimum TDN requirements. This procedure means that much higher crude protein and mineral level is fed than required for brood cows. There is a wide variation in the chemical analysis of broiler litter, and this is probably due to management, climatic conditions, and handling procedures. As broiler litter becomes valuable, less variation in quality can be expected with improved management conditions of litter during broiler production. (Ruffin-Auburn University)

5417-A11, E3, F2 USING LIVESTOCK AND POUL- TRY WASTE IN KENTUCKY

University of Kentucky, Lexington, Kentucky
40506
J.T. Johns
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority
July, 1978, p. 72.

Keywords: Refeeding, Poultry wastes, Live-
stock wastes, Legal aspects, Performance

There are several aspects of Kentucky that limit the refeeding of poultry wastes to cattle. Current state regulations do not allow wastes to be sold as a feed supplement. Also broiler production in Kentucky is centered in a two-to three-county area which does not produce many cattle. Only two producers in Kentucky are recycling waste as a feed ingredient. Both feed the waste to cattle. One of the producers dries caged layer manure and uses it in a finishing ration of 60% ground shelled corn and 40% dried poultry waste. No supplemental protein is used and feed consumption is up to expected values. Gains and slaughter grades of the cattle have been satisfactory. The other producer is using wet and dried cage layer waste in a cow and calf and backgrounding program. Gas prices for drying have become so expensive that the producer has turned entirely to the use of wet waste. It averages 30% to 35% dry matter and has been mixed with corn silage and stored in a trench silo. The material is used directly with the wintering cow herd or is mixed with shelled corn and used in a growing ration. Consumption and condition of the wintering cows have been excellent and gains of growing cattle have been very satisfactory. (Merryman-East Central)

5418-B3, E3 FEEDING POULTRY WASTE IN NORTH CAROLINA

North Carolina State University, Raleigh,
North Carolina 27607
R. Crickenberger
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 72-73.

Keywords: Poultry wastes, Poultry litter,
Refeeding, Cattle, Ensilaging

In North Carolina, broiler litter is the major poultry waste material being fed to cattle. Several types of feeding systems are used and include: (1) broiler litter + grain, (2) broiler litter + roughage + grain, (3) broiler litter + corn silage (mixed at ensiling or feeding), and (4) broiler litter + crop residues. Broiler litter is typically stored either in oxygen-free silos, pit silos, or bunkers, or it may be stacked. Problems encountered with litter feeding include: (1) an adequate and economical storage system, (2) adequate dry matter and energy intake, (3) proper nutrient analyses and ration formulation, (4) removal of hardware, and (5) "most profitable feeding" vs "lowest feed cost/lb of gain". Many producers have access to caged layer manure, and they are seeking ways to use this material in feeding programs. Research suggests that ensiling may be an economical and effective method of reducing numbers of pathogens present in poultry wastes. It is hoped that such ensiled wastes can be mixed with various levels of grain to yield rations containing sufficient energy and protein to support desired performance in feedlot and stocker cattle as well as brood cows. (Merryman-East Central)

5419-A11, A12, B3, E3, F2 VIRGINIA AGRICULTURAL WA- STE FEEDING REGULATIONS

Virginia Department of Agriculture and
Commerce
G.A. Pearson

Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 76-77.

Keywords: Refeeding, Poultry wastes, Live-
stock wastes, Legal aspects, Public health,
Animal health, Waste composition

Mr. Pearson discusses the aspects that should be considered in developing regulations for feeding agricultural wastes to ruminants as well as other animals. The first consideration is safety of the product to the animals and the consumer of the meat, milk, or eggs produced by the animals. Generally, with proper processing, the drug residues in processed animal wastes are relatively low and can be dealt with by using a 15-day withdrawal period. A second consideration is pesticide residues. A third area of concern is pathogenic organisms. Also uniformity of the waste products is a legitimate concern. This can be overcome in the definitions and standards of quality. Commercial feed laws in various states require product registration, plant registration, or processed registration. Under the Virginia Commercial Feed Law, there is one regulation dealing with the use of dried poultry wastes as a commercial feed ingredient. Mr. Pearson states that at present he does not believe the feeding of wastes to be economical to commercially process, however. (Merryman-East Central)

5420-E3, F1 ALABAMA AGRICULTURAL WA- STE FEEDING REGULATIONS

Alabama State Board of Agriculture and
Industries
J. Kirkpatrick
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 77-80.

Keywords: Refeeding, Animal wastes, Legal
aspects

Mr. Kirkpatrick discusses the highlights of Alabama's regulations concerning processed animal waste (PAW) and outlines the administrative position relative to the enforcement of the regulations. "Processed" when applied to animal waste means "thermally dehydrated, dry stacked, ensiled, oxidized, chemically treated, microbiologically digested, chemically or physically fractionated or treated by some other process, which will enable the product to comply with quality standards as set forth in Section V of the regulations". Section V specifically prohibits offering for sale or selling any PAW without properly registering the product with the Commissioner of Agriculture and Industries. Likewise, offering for sale or selling PAW or feed containing PAW is prohibited unless the processor first complies with the quality standards outlined in Section V, properly labels the product as required by Section VI, adheres to the testing protocols established by Section VII, and obtains the necessary operating permit from the commissioner as required by Section VIII. The Section V "Quality Standards" require that PAW or feed containing PAW sold or offered for sale not contain extraneous materials such as metal, glass, nails, or other harmful matter, except as may be allowed in undried PAW, wherein the regulations allow up to 40% straw, wood-shavings, or other bedding materials. Specific quality standards are set forth for dried poultry waste, dried poultry litter, and dried ruminant waste. These standards establish the minimum requirements for protein and maximum levels for

crude fiber, ash, percentage of feathers, and percentage of moisture which will be acceptable when these materials are sold or offered for sale in Alabama. Labeling requirements are about the same as those established under the Alabama Commercial Feed Law. Necessary warning statements are required should the PAW product contain residues of certain drugs or heavy metals. Persons receiving approval for registration of PAW products must test, by approved representative sampling techniques and assaying methods, samples of each lot of PAW product for which registration is issued. The results of such sampling analysis must be maintained in records of the registrant and must be made available to the commissioner as he may require. (Merryman-East Central)

5421-E3, F1 REGULATORY ASPECTS OF FEEDING AGRICULTURAL WASTES TO RUMINANTS IN GEORGIA

Georgia Department of Agriculture
C.R. Spooner
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 82.

Keywords: Refeeding, Animal wastes, Legal aspects

Under the Georgia Feed Law, animal waste feed ingredients may now be registered and regulated. Thus far only one company registered such a product and it failed to renew the product registration the next year. However, plans are under way by several companies to develop a product and set up a marketing plan. In order for animal waste feed products in Georgia to be marketed across state lines, regulations have recently been drawn up for processed animal waste. To be successful in the plan of feeding animal waste, a clean product must be produced and necessary guidelines must be followed. Otherwise, the plan will be denied by regulatory agencies, FDA, and the general public. (Merryman-East Central)

5422-B3, F1 REGULATION OF RECYCLED WASTES AS ANIMAL FEEDS IN MISSISSIPPI

Mississippi State Chemical Laboratory
J.P. Minyard, Jr.
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 82-85.

Keywords: Refeeding, Legal aspects

Commercial recycled wastes sold as animal feeds must be of specific quality, of uniform composition, safe, labeled for proper use, and under manufacturers' quality and distribution control at all times. Four regulatory concerns that apply to such waste products are: (1) product nutritional composition (quality and uniformity), (2) product safety, (3) labeled use, and (4) distribution of products. There must be labeled guarantees for minimum or maximum content (such as protein, fiber, ash, and moisture). The product must be monitored by laboratory tests by the manufacturer. The manufacturer is required to

maintain product information such as records of analyses and sale of specific lots to specific customers. Methods of state promulgation of regulations are to: (a) use Association of American Feed Control Officials (AAFCO) definitions of each product and also use the state feed bill, if essentially the AAFCO model bill, and (b) use a self-contained AAFCO model set of regulations. Proposed model regulations (AAFCO self-contained regulations) for processed animal waste products as animal feed ingredients which were drafted October, 1977 are presented. (Merryman-East Central)

5423-A11, C2, D3, E3, F1, F4 ECONOMIC ASPECTS OF FEED- ING WASTE TO RUMINANTS

TVA National Fertilizer Development Center
W.J. Free
Alternate Nitrogen Sources for Ruminants,
Bulletin Y-130, Tennessee Valley Authority,
July, 1978, p. 86-90. 2 tab., 90 ref.

Keywords: Refeeding, Poultry wastes, Livestock wastes, Cattle, Performance, Waste composition, Economics, Ensilage, Protein, Nitrogen, Phosphorus, Potassium

The use of poultry and livestock waste in ruminant rations appears economically and nutritionally feasible. The nutrient content of poultry litter varies widely between batches and between farms. Therefore, its value nutritionally and economically must be evaluated on the merit of each batch. Feed and fertilizer prices also influence the upper value limit of animal waste when substituted for other ingredients in ruminant rations. As the distance between source of supply and location of feed use increases, the cost of manure increases rapidly relative to value because of moisture and litter. While feeding litter directly from the poultry house represents the least cost method, ensilage in a conventional silo or by deep stacking is recommended as a means of destroying pathogens. Opportunities for drying animal waste with heat from fossil fuels appears limited as the cost of fuel increases. Older cattle can utilize waste more efficiently than younger cattle. Therefore, a larger proportion of the ration for wintering beef cows can be poultry litter. Cost of rations for backgrounding beef cattle and for growing dairy heifers can be reduced by using poultry litter. Poultry litter can also be used as a protein supplement in feedlot rations with little effect on rate of gain. Little effort has been made to evaluate the allocation of benefits from using poultry waste to the poultry producer versus the ruminant producer. This area needs further study. Perhaps by working together, nutrient content of poultry litter might be stabilized if cattle feeders were willing to pay the cost of standardizing. In conclusion, animal waste provides a large potential supply of feed for ruminants, particularly the protein part of ruminant diets. For cattle producers located near poultry producers, poultry litter offers a means of reducing feed cost as long as the litter price reflects short-distance transportation, handling and storage. (Free-TVA National Fertilizer Development Center)

5424-B2, D3, E3 THE DESIGN OF A FULL-SCALE EXPERIMENTAL FERMENTA- TION FACILITY

Project Design Manager, Hamilton Standard,
Division of United Technologies, Windsor
Locks, CT
A.K. Davenport
Paper No. 78-4567, American Society of
Agricultural Engineers, 1978 Winter Meeting,
Chicago, Illinois, Dec. 18-20, 1978, 9 p. 3 fig.

Keywords: Design, Recycling, Cattle wastes, Anaerobic, Fermentation, Design, Temperature, Hydraulic retention, Methane, Feed supplement

The system design described in this paper is for an experimental facility which utilizes anaerobic fermentation of cattle residue for the purpose of producing a methane-rich fuel gas and a protein-rich cattle feed. It is a flexible experimental facility sized to accept 22,730 kg per day of organic material (DWB) in the form of cattle feedlot residue. The main objective of the system is to demonstrate the practical and economic operation of the process at the design point of 55°C with a hydraulic retention time of 10 days. The system has been designed to operate over a wide range of conditions with safety and reliability. Fermentation can be attempted at temperatures as high as 65° and with retention times as low as 3 days. In addition the ability to control the incoming residue both physically and chemically has been included in the design. Operation of the system will provide valuable information on the reliability and stability of the process on a large scale under actual field conditions. This will allow an assessment of the efficacy of the process as a means of recovering energy and food value from cattle residue from both a technical and an economic viewpoint. It will also allow comparison of process to other competitive processes. (Davenport-Hamilton Standard)

5425-B2, C1, C2, D3, E3, F1 OPERATION OF 390 m³ DIGEST- ER AT THE WASHINGTON STATE DAIRY FARM

Ecotope Group

E. Coppinger, R.E. Hermanson, and D. Baylon
Paper No. 78-4566, American Society of
Agricultural Engineers, 1978 Winter Meeting,
Chicago, Illinois, Dec. 18-20, 1978, 21 p. 5
fig., 6 tab., 17 ref.

Keywords: Anaerobic digestion, Dairy Industry, Recycling, Design, Energy, Economics, Waste composition

The operation and performance of a large scale anaerobic digester processing waste from a 180-cow dairy in Monroe, Washington is presented. Energy production has achieved the equivalent of 1880 GJ/year. The feasibility of generating electricity with an internal combustion engine and the life cycle economics of gas and electricity production are examined. (Coppinger-Ecotope Group)

5426-B2, C2, D2, D3 NUTRIENT CHANGES DURING STORAGE OF ANAEROBIC DI- GESTER EFFLUENT

Agricultural Engineering Department, The
Pennsylvania State University, University
Park, Pennsylvania 16802

H.D. Bartlett, L.E. Lanyon, L.J. Stearns, A.E. Branding, and S.P. Persson
Paper No. 78-4563, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 21 p. 8 fig., 4 ref.

Keywords: Anaerobic digestion, Dairy wastes, Phosphoric acid, Nitrogen loss, Waste storage, Aeration, Slurries

The effect of phosphoric acid additions on nitrogen losses from influent and effluent for a dairy manure anaerobic digester during aerobic and anaerobic storage was evaluated during a 60 day period. The additions were most effective at the highest rate and show potential by conserving biologically-fixed nitrogen. (Bartlett-Pennsylvania State University)

5427-D3, E3 NEW GENERATOR TURNS MANURE TO GAS

Anonymous
Farm Industry News South, V. 1, No. 1, p. 14, Jan., 1979, 1 fig.

Keywords: Livestock wastes, Methane, Proteins, Refeeding, Recycling

The ProThane generator, scheduled to be available from Southwestern Porcelain, Inc., Sand Springs, Oklahoma, utilizes new technology to process manure into methane gas and single cell protein (an excellent and economical substitute for soybean meal or alfalfa). The digester is designed for livestock producers having at least 100 dairy cows, 200 beef cattle, or 1,000 feeder pigs in confinement. The major pieces of equipment in the ProThane generation system include the ProThane generator, heater, heat exchanger, BioMaster storage container, and carbon dioxide stripper. The daily process involves liquid manure from the manure storage pit being pumped through the heat exchanger and into the generator. At the same time each day, an equal amount of liquid is removed from the generator and passed through the BioMaster feed separator which removes the single cell protein and drops it into the feed storage bin. Remaining manure is transferred through the shell side of the heat exchanger, where the heat is transferred to the incoming manure. The manure is then transferred to the lagoon or storage structure where it is held for later application to the soil. In cold weather, part of the methane gas produced is used in the water heater to supplement the heat obtained from the exiting liquid. The carbon dioxide stripping loop operates continuously and also provides the necessary stirring for the generator. (Stiles-East Central)

5428-B2, C1, C2, C3, D3, E3, F1 METHANE AND PROTEIN PRODUCTION FROM ANIMAL FEEDLOT WASTES

Roman L. Hruska Meat Animal Research Center, Science and Education Administration/AR, U.S. Department of Agriculture, Clay Center, Nebraska 68933
A.G. Hashimoto, Y.R. Chen, and R.L. Prior
Soil Conservation Society of America, 33rd Annual Meeting, Denver, Colorado, July 30-Aug. 2, 1978, 23 p. 6 fig., 4 tab., 11 ref.

Keywords: Fermentation, Anaerobic, Recycling, Methane, Proteins, Feedlot wastes,

Economics, Waste composition

The technical and economic feasibility of recovering methane and protein from animal feedlot wastes was assessed. Studies on the kinetics of methane fermentation showed maximum specific growth rates were highest at about 42°C for mesophilic bacteria and 62°C for thermophilic bacteria. Inhibition of methane fermentation started at an influent volatile solids (VS) concentration of 80 g VS/l and increased rapidly as the influent VS concentration increased above 80 g VS/l. Simulations based on experimentally derived kinetic constants showed that the optimum influent VS concentration was about 80 g VS/l. Total annual costs were calculated for feedlots ranging from 1,000 to 100,000 head. The total annual costs decreased from \$100/head/yr for the 1,000 head feedlot to \$16.1/head/yr for the 100,000-head feedlot. The value of the net energy production was \$7.1/head/yr. The value of the fermenter effluent as a protein supplement was estimated to be \$82.9/head/yr, assuming complete recovery and usage as feed. Based upon these figures, the feedlot size at which the credits equal the total annual costs ranged between 1,000 to 2,000 head. Areas requiring technological development or refinement to make the anaerobic fermentation system more widely applicable and/or acceptable were discussed. (Hashimoto-USDA)

5429-A3, A4, C3 BACTERIAL VARIATIONS IN STREAMS FROM A SOUTHWEST IDAHO RANGELAND WATERSHED

Northwest Watershed Research Center, ARS-USDA, Boise, Idaho 83701
G.R. Stephenson and L.V. Street
Journal of Environmental Quality, V. 7, No. 1, p. 150-157, Jan.-March, 1978, 5 fig., 1 tab., 29 ref.

Keywords: Water pollution, Agricultural runoff, Nonpoint sources, Bacteria, Rangeland, Pastures

Sources and variations in bacterial indicators are reported from stream sites over a 3-year period on a 233-km² rangeland watershed in southwest Idaho. The occurrence of fecal coliforms was directly related to the presence of cattle on summer range and winter pastures. Fecal coliform counts in adjacent streams were found to increase soon after cattle were turned in and remained high for several months after cattle were removed. Runoff from rainstorms increased both total and fecal coliform concentrations in streams on summer range with limited management and adjacent to winter pastures, but runoff from snowmelt had little effect. Total coliform counts varied more with change in streamflow than did fecal coliform counts. In fenced summer range allotments, under deferred grazing management, the effects were the same, except bacterial counts were not as high or persistent. The decrease in bacterial concentrations at several downstream sampling sites indicated that certain stream segments were self-purifying. The presence or absence of livestock along the streams overshadow any effect variations in chemical concentration of the water might have on bacterial concentrations. (Stephenson-USDA)

5430-A2, B2, D3

DESIGN OF VEGETATIVE FILTERS FOR FEEDLOT RUNOFF TREATMENT IN HUMID AREAS

Department of Agricultural Engineering, University of Illinois, Urbana-Champaign, Illinois

D.H. Vanderholm and E.C. Dickey
Paper No. 78-2570, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 10 p. 2 fig., 3 tab., 4 ref.

Keywords: Waste treatment, Design, Vegetative filters, Feedlot runoff, Overland-flow, Channelized flow

Vegetative filters can provide a satisfactory, low-cost means of controlling feedlot runoff for many small and medium-size livestock feedlots. Such filters are not adaptable to every situation, however, and some management is required for satisfactory performance. Proposed design criteria have been developed for overland-flow and channelized-flow systems and are presented here. Channelized-flow systems appear to be less effective than overland-flow systems, requiring a much greater flow length for a similar degree of treatment. However, achieving uniform distribution and true overland flow is difficult. Further research is needed to verify our results for other conditions and to refine the proposed design criteria. The acceptance of the vegetative filter system by farmers appears to be much better than that for conventional treatment systems with holding ponds. Thus, the vegetative filter is likely to be adopted much more readily than conventional systems by operators of smaller feedlots, resulting in the reduction of pollution problems associated with feedlot runoff. The concept of a discharging vegetative filter system will have to be approved by pollution control agencies before such systems can be recommended and used widely. (Vanderholm-ASAE)

5431-A3, C1, C2, D3 EFFECTIVENESS OF GRASS BUFFER ZONES IN ELIMINATING POLLUTANTS IN RUNOFF FROM WASTE APPLICATION SITES

Soil Conservation Service, USDA, Raleigh, North Carolina
S.C. Bingham, M.R. Overcash, and P.W. Westerman

Paper No. 78-2571, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 34 p., 12 fig., 5 tab., 19 ref.

Keywords: Land application, Poultry wastes, Agricultural runoff, Grass buffer zones, Water quality, Infiltration

Research objectives were: (1) to experimentally determine the effectiveness of several lengths of grass buffer zones in improving the water quality of surface runoff from land application areas and (2) to develop a model based on hydraulic processes to predict reduction of the pollution potential as the pollutants proceed through the buffer zone. It was found that applying poultry waste to land application areas resulted in an increase of the rainfall-runoff pollution potential. Total Kjeldahl nitrogen, T-P, COD, TOC, NO₃-N and Cl concentrations and the volatile solids/total solids ratio were measured in the composite

runoff sample at various buffer area length/waste area length ratios. Grass buffer zones effectively reduced the pollution potential to that of surrounding area concentrations at a 1.0 buffer area length/waste area length ratio on the clay loam soil studied. Comparing the percent reduction in concentration of the experimental results with the model, an infiltration rate/rainfall rate ratio (D-factor) of 0.7 was found to characterize the clay loam soil studied. Consequently, a buffer area length/waste area length (B/W) ratio of 1.0 is required to reduce the concentration between 90% and 100%. Depending on the magnitude of the pollution potential, a smaller percent reduction may be used to reduce the concentration to a desired water quality; thus, a buffer area length/waste area length ratio slightly less than 1.0 may be used. (Merryman-East Central)

5432-A2, C1, C2, C3, D3 EFFECTIVENESS OF NON- STRUCTURAL FEEDLOT DIS- CHARGE CONTROL PRACTICES

Agricultural Engineer, USDA, Science and Education Administration, Agricultural Research, Morris, Minnesota
R.A. Young, T. Huntrods and W. Anderson
Paper No. 78-2572, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 12 p. 1 fig., 5 tab., 8 ref.

Keywords: Feedlot runoff, Buffer strips, Pollution control, Coliforms, Nitrogen, Phosphorus, Total solids

Based on rainulator from 2 years of testing, nonstructural feedlot discharge control practices seem to hold some promise for providing possible alternative methods of controlling the pollution potential of feedlot runoff. For all of the cropping treatments tested, runoff and total solids removal were reduced by an average of 70 and 92 percent, respectively, as the discharge from the feedlot passed through the buffer strips. Concentrations of TN, and TP were reduced by an average of 84 and 59 percent, respectively. $\text{NH}_4\text{-N}$ and $\text{PO}_4\text{-N}$ concentrations were similarly reduced but $\text{NO}_3\text{-N}$ concentration in the runoff increased, mostly on the orchard grass and the oat buffer strips. Both years resulted in significant reductions in the number of coliform organisms in the runoff water after passing through the vegetated buffer strips. Buffer strip lengths of 35.8 m would appear to be sufficient to reduce concentrations of both nutrients and microorganisms in feedlot runoff from summer rainstorms on feedlot areas of the size tested to an acceptable level. (Young-USDA)

5433-A7, F1 THE EFFECT OF FAN CONTROL SYSTEMS ON THE COST OF MECHANICAL VENTILATION

Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853
L.D. Albright and G.W. Cole
Paper No. 78-4506, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 12 p. 1 fig., 5 tab., 8 ref.

Keywords: Ventilation, Fans, Costs, Design

An analysis procedure is developed to predict the yearly duty factor of a barn ventilating fan system. The procedure is based on building characteristics and the ambient conditions. Various factors are investigated which affect the duty factor, and thereby the cost of operating a mechanical ventilation system. (Albright-Cornell)

5434-A2, B2, D1, D3, F1 EXPERIENCES WITH RUNOFF CONTROL SYSTEMS IN INDIANA

Extension Agricultural Engineer, Department of Agricultural Engineering, Purdue University, West Lafayette, Indiana 47907
J.C. Nye and D.D. Jones
Paper No. 78-2574, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 10 p. 2 tab., 14 ref.

Keywords: Feedlot runoff, Legal aspects, Settling basins, Infiltration, Vegetative filters, Design

Indiana state laws have required livestock producers to control feedlot runoff for 7 years. This paper describes how settling basins and infiltration areas/vegetative filters have been used to control the runoff. Recommendations are presented for the design of these systems. (Nye-Purdue University)

5435-A7, A11, B1 PREDICTING BROILER HOUSE AIR QUALITY DURING POWER FAILURES

Agricultural Engineering Department, University of Delaware, Newark, Delaware 19711
N.E. Collins, P.F. Brooks, E.W. Walpole, and J.P. Jones
Paper No. 78-4507, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 34 p. 20 fig., 10 ref.

Keywords: Poultry, Air pollution, Temperature, Humidity, Carbon dioxide, Oxygen, Animal health

Based on the computer simulation of events in a broiler house with an inoperative ventilation system, the following conclusions are drawn: (1) Mortality is induced by high room temperature and relative humidity. (2) Carbon dioxide and oxygen levels do not reach lethal limits. (3) With limited area brooding practices, critical periods are 5 to 7 days prior to partition removal. (4) Mortality occurs sooner in houses designated to reduce energy consumption (House "C"). (5) Infiltration due to typical wind and thermal forces is not great enough to prevent lethal conditions. (6) Mortality can occur within three hours of a power failure. (Collins-University of Delaware)

5436-A2, A4, B2, C1, C2 A MATHEMATICAL MODEL TO PREDICT IMPACTS OF LIVE- STOCK WASTE RUNOFF ON RECEIVING STREAMS

S. Wlencke, D.B. George, D.S. Filipp, B. Finney, W.J. Grenney, and J.H. Reynolds
Paper No. 78-2512, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 43 p. 16 fig., 9 tab., 15 ref.

Keywords: Cattle wastes, Agricultural runoff, Water pollution, Mathematical models, Waste composition

A two-year study was conducted which assessed the potential waste load contribution from beef and dairy cattle feedlots to a hydrological drainage system. A mathematical model was developed as a management tool to predict the amount and characteristics of feedlot runoff occurring during rainfall, snow, and snowmelt events. It was concluded that: (1) The concentration of pollutants in runoff is directly influenced by precipitation prior to the runoff event. Rainfall runoff was affected by up to 5 days prior precipitation. Snowmelt runoff was affected, depending on parameters, up to 4 days prior precipitation. (2) The predictive model computes mass loading of pollutants from feedlot facilities primarily as a function of available feedlot area. Reduction of enlargement of feedlot area is directly proportional to mass loading of pollutants. This assumes that cattle density per feedlot was essentially constant. (3) The concentrations of COD, BOD₅, $\text{NH}_3\text{-N}$, SS, VSS, and TP in winter or snowmelt runoff is six to eight times higher than in summer or rainfall runoff for paved and unpaved feedlots. (4) The correlation between COD and BOD₅, COD and TP, and VSS and SS were high. Relationship between TP and PO_4 was extremely low. (5) Paved or unpaved facilities directly affect the concentration of COD, BOD₅, $\text{NH}_3\text{-N}$, TP, PO_4 , VSS, and SS within the feedlot runoff for either rainfall or snowmelt. (6) Feedlot runoff occurs during winter months mainly due to freezing and thawing of snowmelt. The freezing-thawing process is a continual process having an effect over a particular daily period dependent on temperature and number of sunny days. (Merryman-East Central)

5437-A5, A8, B2, E2 FESCUE AND COASTAL BER- MUDAGRASS NUTRIENT RE- COVERY FROM SWINE ANAERO- BIC LAGOON EFFLUENT

Biological and Agricultural Engineering Department, North Carolina State University, Raleigh, North Carolina 27650
P.W. Westerman, M.R. Overcash, J.C. Burns, and L.D. King
Paper No. 78-4561, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 37 p. 6 fig., 18 tab., 12 ref.

Keywords: Swine wastes, Anaerobic, Irrigation, Fescue, Coastal bermudagrass, Crop response, Soil-water-plant relationships

Irrigation of swine lagoon effluent on Coastal bermudagrass-Norfolk sandy loam plant-soil sites for four years demonstrated that lagoon effluent can adequately supply these crops' nutrient needs for these number of years without any nutrient amendments. The irrigation showed excellent nutrient utilization of N and K for low-rate treatments on Coastal bermudagrass. The Coastal bermudagrass crop removal of N and K compared to applied amounts (about 350 kg/ha) averaged about 70% for the first five years. The lagoon TKN was mostly $\text{NH}_4\text{-N}$ and was therefore readily

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available for nitrification and plant uptake. However, this also meant that N losses could be expected with sprinkler irrigation. TKN losses averaged about 25% when comparing concentrations of lagoon effluent with concentrations of irrigated effluent collected in cups on the plots. Winter kill, which occurred in the winter of 1976-1977, demonstrated that Raleigh, North Carolina and places of similar climate may be borderline for reliable, long-lived use of Coastal bermudagrass as an effluent acceptor. Tall fescue yields were always greater for irrigated plots than for non-irrigated plots. However, the irrigated plots received higher loading rates of nutrients and water. Yields from the plot receiving slurry from a slatted-floor pit improved with time in relation to plots receiving inorganic fertilizer, probably due to increased mineralization of organic N and possibly improvement of soil properties near the surface. It was found that water quality considerations are probably the limiting factor in determining maximum application rates. Periods and amounts of application should also be adjusted to the crop and soil characteristics. (Merryman-East Central)

5438-A5, B1 ENVIRONMENTAL EFFECTS UPON POULTRY HOUSE AEROSOLS

Agricultural Engineering Department, University of Idaho, Moscow, Idaho
R.C. Stroh, J.E. Dixon, C.F. Peterson, E.A. Sauter, J.F. Parkinson, and E.E. Steel
Paper No. 78-4510, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 12 p. 8 fig., 8 tab., 13 ref.

Keywords: Air pollution, Dusts, Poultry houses, Humidity, Temperature, Bird density

Four environmentally controlled rooms located on the University of Idaho poultry farm were prepared to measure airborne particulates. The results concluded that bird density was the most significant factor affecting large dust particles. Higher relative humidities tended to slightly increase the number of larger particles, while temperature had minimal influence. (Stroh-University of Idaho)

5439-B3, D1 DRYING RATE OF COW PAUNCH CONTENTS AS AFFECTED BY HUMIDITY, DEPTH AND AGE

Agricultural Engineering Department, Oklahoma State University, Stillwater, Oklahoma 74074
C.L. Griffith and G.H. Brueewitz
Paper No. 78-3553, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 20 p. 7 fig., 3 tab., 14 ref.

Keywords: Drying, Paunch manure, Driers, Design, Humidity, Depth

A tunnel dryer was constructed to measure the rate of drying of abattoir cow paunch contents as a function of relative humidity, depth, and age during constant temperature and airflow conditions. The drying rate was highest for a thin layer and low humidity air. The drying rate was affected most by age at the medium to high humidities and least by depth. (Griffith-OSU)

5440-A8, B2, B4, C1, C2, D3, E2 ANAEROBIC LAGOON EFFLUENT AS FERTILIZER IN MISSOURI

Department of Agricultural Engineering, University of Missouri, Columbia, Missouri
C.D. Fulhage, J.H. Porter, and J.R. Fischer
Paper No. 78-4560, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 14 p. 4 fig., 3 tab., 2 ref.

Keywords: Lagoons, Anaerobic, Dairy wastes, Swine wastes, Land application, Vegetative filters, Waste composition, Solids, Nitrogen, Potassium, Sodium, Calcium, Magnesium, Electrical conductivity, Copper, Zinc, Trace elements, Soil contamination

Anaerobic lagoons are the primary storage-treatment component of livestock waste management systems in Missouri. Proper lagoon management includes regular pumpdown to utilize fertilizer nutrients and minimize pollution risk. The sludge layer contains a significant portion of the solids in a lagoon, and must be considered in evaluating lagoon performance. The sludge layer typically contains 80-90% of the dry matter in Missouri swine lagoons. Volatile solids/total solids ratio is significantly lower in the sludge layer than in the liquid. Volatile solids and total solids reductions of 0.087 and 0.70 are estimated for typical swine lagoons. Missouri swine lagoons are estimated to have a potential life of 20-25 years before sludge volume reduces the permanent volume required for good bacterial activity. Nitrogen, potassium, and sodium are contained primarily in the liquid fraction, and phosphorus appears in greater quantity in the sludge layer. About 15-20% of the solids input to a Missouri swine lagoon will be removed by pumpdown. With vegetative filter areas sized according to regulation, a nitrogen application rate of 78-112 Kg/ha (70-100 lb/acre-inch) results from a typical annual pumpdown of a swine lagoon. Lagoon nitrogen levels compared to estimated raw manure input nitrogen indicates a loss of 80% of the nitrogen voided by the animal. Average annual pumpdown of dairy lagoons results in the application of 105-157 Kg/ha (94-140 lb/acre) nitrogen to properly sized vegetative filters. Sodium, calcium, and magnesium are not expected to present a salt hazard to most Missouri soils at recommended effluent application rates. Electrical conductivity, a convenient field measurement, will allow an acceptable estimate of effluent nitrogen levels to be made. (Fulhage-University of Missouri)

5441-A6, A8, A10, A11, B2, C1, C2, C3, D3, E2 MELBOURNE, AUSTRALIA, WASTE- WATER SYSTEM -- CASE STUDY

Melbourne and Metropolitan Board of Works, Australia
A.H. Croxford
Paper No. 78-2576, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 41 p. 7 fig., 12 tab., 15 ref.

Keywords: Lagoons, Irrigation, Land application, Overland flow, Filtration, Pastures, Grazing, Design, Heavy metals, Waste composition, Nitrogen, Phosphorus, Odor, Flies,

Mosquitoes, Animal health, Soil-water-plant relationships, Solids, Bacteria

Wastewater from the City of Melbourne, Australia is effectively and economically treated at Werribee Farm by land filtration, grass filtration (overland flow) and lagooning. Cattle and sheep grazing is an integral part of land filtration. The Farm (Est. 1897) is one of the world's largest land treatment installations. (Croxford-Melbourne and Metropolitan Board of Works)

5442-A3, A4, A9, B1, C2, F1, F2 BEST MANAGEMENT PRACTICES FOR AGRICULTURE AND SILVICULTURE

Environmental Studies Program, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York
R.C. Loehr, D.A. Heath, M.F. Walter, and C.S. Martin
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, 740 p.

Keywords: Agriculture, Silviculture, Management, Nonpoint sources, Agricultural runoff, Livestock wastes, Economics, Pesticides

This proceedings focuses on Best Management Practices (PL 92-500) in agribusiness and forestry to minimize pollutive effects while maximizing agriculture production. Six main sections encompass topics ranging from 206 implementation to social costs and pragmatic models for pollution control. Topics considered include: (1) approaches for BMP selection, (2) nutrient management, (3) silviculture, (4) economic, policy and institutional aspects, (5) state and watershed approaches, and (6) modeling studies. This book is authoritatively written and gives indispensable reference information of practical benefit to: sanitary and agricultural engineers, farm managers, agriculturalists, forest managers, government agencies, environmentalists, food suppliers, libraries, etc. (Merryman-East Central)

5443-A4, B1, F2 NONPOINT SOURCE POLLUTION CONTROL STRATEGY

Deputy Director, Water Planning Division, U.S. Environmental Protection Agency, Washington, D.C.
W.S. Grozyk
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 3-16.

Keywords: Water pollution, Nonpoint sources, Environmental Protection Agency, Best Management Practices, Legal aspects, Cost-sharing, Clean Water Act

Two amendments in the Clean Water Act of 1977 provide those who are working with Section 208 agencies and EPA with additional ways to implement nonpoint source control programs, and thus solve some of our critical water quality problems. Two major elements of EPA's nonpoint source control program are: (1) to accelerate the implementation of

nonpoint source (NPS) control programs and the application of Best Management Practices (BMPs) and, (2) to focus available resources on solving the most severe problems first. Accelerated implementation of 208 programs and application of known controls for pollutants causing water quality problems is a major emphasis of EPA's water programs. One reason for this is to allow owners and operators to become eligible for cost-sharing money, and the second is that EPA and OMS have agreed that no further planning money is to be awarded to an agency beginning in Fiscal Year 1980 if implementation is not occurring. Section 208 agencies, state- and area-wide, have prioritized their water quality problems and are to develop control plans for the most severe problems first. The governor, based on the priorities in the 208 plans, will recommend in order of priority, project areas for cost-sharing assistance. Initially only the highest priority project areas proposed in each state will receive consideration. The BMPs that are to be cost-shared must have a positive effect on water quality by either (1) preventing or abating the amount of pollutant entering the stream, or (2) reducing the amount of the pollutant that is applied to the land. The focus of the program is on agricultural practices, which can include farm woodlot operations. Cost-sharing assistance will be available for only privately owned lands. The primary objective of the program is to cost-share practices to the extent required to ensure installation of the practices. The act provides for a 50% cost-share rate. A reauthorization of funding for 304 (d) provides money for federal agencies to assist and implement 208 plans. This funding is to serve as a catalyst to bring federal agency expertise to state and local agencies to help them solve critical water quality management problems and to expedite the implementation of water quality management programs. Funds will not be used to replace existing federal resources but will be used to increase and accelerate the ongoing programs. (Merryman-East Central)

5444-A4, B1, F2 A STATE PERSPECTIVE ON NONPOINT SOURCE MANAGEMENT

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Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 17-24.

Keywords: Water pollution, Nonpoint sources, Best management practices, Legal aspects

Preventing water pollution from nonpoint sources is an important public challenge. In New York, this challenge can best be met through a three pronged approach: (1) participation by every land owner in the existing cooperative soil and water conservation program; (2) identification of serious nonpoint water quality problems for special priority attention; (3) development of "Best Management Practices" (BMPs) tailored to meet New York's unique physical, economic and agricultural conditions. In addition to participation of land owners in soil and water conservation, New York's 208 program has two major goals: (1) to assess the magnitude and geographic extent of nonpoint source pollution problems and to identify areas for priority attention; and (2) to develop systems of BMPs consistent with the ethic of good

conservation which can be implemented to control nonpoint source pollution. BMPs should be systems of land management practices which are the most economical, practical and reasonable, all factors considered, in achieving water quality goals. In practice, the implementation of this concept is extremely difficult. Technically, much of the information needed is new and relatively unexplored. Therefore, initial BMP systems must of necessity be rudimentary and carefully designed to stay within the limits of current knowledge. New York has contracted with the College of Agriculture and Life Sciences at Cornell University to develop the framework for a system of Agricultural Best Management practices for the state. New York has also contracted with the Applied Forestry Research Institute at State University of New York College of Environmental Science and Forestry, Syracuse, to conduct a similar study on Silvicultural Management Practices. Also studies have been contracted in three example watersheds in the state, and we have been working closely with the State Soil and Water Conservation Committee. (Merryman-East Central)

5445-A4, B1, F2 RESEARCH NEEDS AND CURRENT ACTIVITIES

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T.A. Murphy
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 25-30.

Keywords: Nonpoint sources, Water pollution, Best management practices, Environmental Protection Agency, Legal aspects

The 1974 prediction that by 1978/79 we would see "major decisions regarding control of nonpoint sources" has been confirmed. We have developed the BMP (Best Management Practices) concept that agricultural pollution can best be controlled by management practices adapted to specific site conditions rather than by uniform national or regional effluent requirements. We have realized that BMPs are not necessarily free - somebody has to pay. This recognition is clear in the Rural Clean Water Program (RCWP). We have learned that agricultural water quality management cannot be addressed independently, but only in the context of overall crop, soil and water management. In recognition of this, we have brought to bear, through the Section 208 planning process, a significant portion of this nation's agricultural technical expertise, to assist in the development and application of BMPs. We have produced many research products during this period which should be useful in selecting and implementing BMPs. The Environmental Protection Agency's research program has been busy developing a number of technical tools during the past 4 years which may be used in the implementation of BMP's. These vary from simple loading functions to sophisticated, computer-based simulation models. While these provide some of the best tools available for implementing BMPs, we are not so confident in our capability to quantitatively predict the reduction of pollutant load or water quality benefits and the costs of BMPs. Consequently, we must define what types of data collection and analysis are required to evaluate how much the BMPs that are put into

practice reduce pollutant loadings and improve water quality. We need to try some of the models and analytical tools that research has produced in the last four years. Attention must be given to possible alternative BMPs. We must look more closely at the economics of BMPs. And finally, it is critical that we keep working together. (Merryman-East Central)

5446-B1, F2 BEST MANAGEMENT PRACTICES FOR AGRICULTURE AND SILVICULTURE: AN INTEGRATED OVERVIEW

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G.W. Bailey and T.E. Waddell
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 33-56. 5 fig., 3 tab., 17 ref.

Keywords: Nonpoint sources, Water pollution, Best management practices, Agriculture, Silviculture, Legal aspects

This paper provides a framework for viewing the identification, selection and implementation of best management practices (BMPs) for controlling nonpoint source pollution from agriculture and silviculture. The various perspectives from which BMPs must be viewed by the planner/decision-maker whose goal is improved water quality are discussed. In reaching this goal, the planner must consider the diverse exogenous forces that impact the system as well as the agriculture/forestry production system. Technical, economic, social and institutional factors must be integrated. Social concerns led to the passage of a host of environmentally related legislation by the Congress of the United States and by the states. These include Federal Water Pollution Control Act of 1972 (PL 92-500), Federal Water Pollution Control Act, As Amended (PL 95-217), and Soil and Water Resources Conservation Act of 1977 (PL 95-192). The approach embodied in PL 92-500 and PL 95-217 for the control of nonpoint source pollution from agricultural and silvicultural activities is source management rather than collection and treatment of pollutants. This approach means that management practices or combination of such practices are the vehicle to use to provide a cost-effective means to prevent or control pollution from agricultural and silvicultural activities. (Merryman-East Central)

5447-A4, B1, F2 CONSERVATION DISTRICT INVOLVEMENT IN 208 NONPOINT SOURCE IMPLEMENTATION

National Association of Conservation Districts, Washington, D.C.
R.E. Williams and J.E. Lake
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 57-67.

Keywords: Nonpoint sources, Water pollution, Soil Conservation Service, Rural Clean Water Program, Legal aspects, Sediment control

Most state district laws provide for establishment of districts as political subdivisions of the state. Although state laws governing conservation districts vary in some respects, their purposes are the same everywhere; that is, to focus attention on land, water, and related resource problems, to develop programs to solve those problems, and to enlist the support and cooperation from all public and private sources to accomplish district goals. Conservation districts are managed by local citizens who know their local problems. Usually districts have from five to seven officials who are either elected or appointed depending on the laws of the particular state. In every district, officials develop and continually maintain a long-range plan which contains facts about the soil, water and related resource problems of their district. The long-range plan also outlines measures that can be taken to correct the problems identified. The long-range plans must continually be updated in order to provide current resource information that is needed to assess current problems and to provide a base for setting new priorities. All districts prepare an annual plan of operations to guide the current year's activities. To accomplish the goals spelled out in the long-range plan and the annual plan of operations, district officials have developed working agreements with many local, state and federal agencies. A recent opportunity for district involvement in Best Management Practices Implementation has arisen out of the new amendments to the Clean Water Act signed by the President on December 15, 1977. The agricultural cost-sharing section introduced by Senator Culver of Iowa authorizes \$200 million in Fiscal Year 1980 to be used for cost-share assistance for implementation of BMPs in rural areas having significant nonpoint water problems identified in the 206 water quality plan. The program which is being developed pursuant to this legislation will be called the Rural Clean Water Program (RCWP). In order for land owners to be eligible for participation in the program, their land must be identified as part of the critical areas addressed in a 206 plan certified by the governor of that state and approved by EPA. The RCWP provides four options to the Secretary of Agriculture through SCS for carrying out the program at the state and local levels. These include entering into agreements for administration for all or part of the program with: (1) soil conservation districts, (2) state soil conservation agencies, or (3) state water quality agencies, or, if none of the above, then (4) transfer of funds from SCS to Agricultural Stabilization and Conservation Service for administration of the program. (Merryman-East Central)

5448-A4, B1, F2 THE ROLE OF CONSERVATION PRACTICES AS BEST MANAGEMENT PRACTICES

U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.
J.S. Johnson
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 69-78. 16 ref.

Keywords: Water pollution, Nonpoint sources, Legal aspects, Best management practices, Federal Water Pollution Control Act Amendments, Soil Conservation Service

The goal of the 1972 Federal Water Pollution Control Act Amendments (PL 92-500) is to restore and maintain the chemical, physical and biological integrity of the nation's waters. The legislation calls for achieving water quality that is suitable for fishing and swimming by 1983 wherever it is practical to do so. As progress is made in controlling municipal and industrial pollution, the problem of nonpoint source pollution becomes more apparent. A concerted effort must be made to control this pollution from diffuse sources if 1983 clean water goals are to be achieved. Because of the relationship of activities on the land to nonpoint source pollution, land management practices will play a major role in the cleanup practices that are looked to for performing this role have become widely accepted as best management practices (BMPs). BMP means the most acceptable practice or combination of practices that has been determined by a state (or designated area wide planning agency) after problem assessment and examination of alternative practices. The goal of BMPs is to ensure that activities on the land do not pollute the nation's streams, lakes and rivers. The soil conservation movement, spearheaded technically by the Soil Conservation Service, has developed programs to solve land and water resource problems. Planning and application of site-specific practices are essential. Soil Conservation Service conservationists are experienced and equipped with the knowledge and technical guides to perform and train others to perform this task. To avoid placing an insurmountable economic burden on American agriculture, a cost-sharing program has been made available via Section 35 of the Clean Water Act of 1977. (Merryman-East Central)

5449-A3, A4, B1, C2 RELATIONSHIPS BETWEEN AGRICULTURAL LAND AND WATER QUALITY

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D.R. Coote, E.M. MacDonald, and R. DeHaan
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 79-92. 5 tab., 11 ref.

Keywords: Nonpoint sources, Water pollution, Agricultural runoff, Phosphorus, Nitrogen, Zinc, Atrazine

This study was conducted to determine the relationships among water quality, pollutant loadings and land use data gathered in watersheds representative of different agricultural areas. The approach taken was to: (1) identify and survey a number of purely agricultural watersheds (non-agricultural land use essentially absent) representative of different agricultural systems in the Canadian Great Lakes Basin; (2) monitor the water quality at the watershed outlet; and (3) examine statistical relationships between the characteristics of these watersheds and the water quality observed at their outlets. A further objective of the study was to provide a basis for predictions of water quality in unmonitored agricultural areas of the Canadian Great Lakes Basin. Data were assembled by which rational selections could be made of the major agricultural areas of the Canadian

Great Lakes Basin and of sites which would represent them. Field studies were conducted. The role of soil particle size as a major influence on phosphorus, organic nitrogen, zinc and atrazine loadings from agricultural land was clearly demonstrated. Consequently, soil texture must be considered when considering remedial measures. The influence of source material availability on stream loadings of the more water-soluble contaminants in streams was evidenced by the loadings of soluble orthophosphorus and nitrate-nitrogen which could be accounted for to a considerable degree by the inputs (fertilizer and manure) of phosphorus and nitrogen, respectively. Endosulfan, a pesticide, was present in relation to the crops on which it was used. Reductions for all of these materials could probably be expected if inputs are reduced, and/or availability to the water system is controlled, e.g., by avoiding contact with surface runoff and by better timing of nitrogen applications to match crop uptake. Results indicated that some materials, such as PCB and copper, are essentially unrelated to any aspect of agriculture. Control of reductions of these should not be expected through any remedial programs applied to agricultural activities. (Merryman-East Central)

5450-B1 ENVIRONMENTAL IMPLICATIONS OF TRENDS IN AGRICULTURE AND SILVICULTURE

Development Planning and Research Associates, Inc., Manhattan, Kansas
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Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 117-131. 1 fig., 2 tab.

Keywords: Agriculture, Silviculture, Management, Pollution control

This paper summarizes major trends within the agriculture and silviculture sectors of the U.S. economy that will most importantly affect each sector's environmental implications in the long term. Panels of national agricultural and silvicultural professionals participated in a workshop to assess the environmental effects of projected trends in agriculture and silviculture. Subsector panels were established under agriculture for the following: (1) Nonirrigated crop production, (2) Irrigated crop production, (3) Feedlot production, (4) Range and pasture management. A subsector was established under silviculture to study silviculture and harvest management. Each subsector panel had an original list of specific trends which they were allowed to modify. After completing their detailed assessments and their aggregate analyses, the fundamental conclusions of each sector's panels were that: *Agriculture* can have, with achievable developments, the capability to supply moderate growth output levels of food, feed and fiber products for the U.S. to 2010 while also maintaining or enhancing the environment affected by agricultural production. *Silviculture* can have, with achievable developments, the capability to supply moderate growth output levels of timber and pulp products for the U.S. to 2010 while also maintaining or enhancing the environment affected by silviculture production. Much must yet be done to achieve the generally favorable potentials for environmental management in agriculture and silviculture. If high exports are desired and needed due to growth output, then even

greater attention and support will be required to maintain or improve the relatively favorable environmental effects of these sectors. Also, the regional environmental implications differ, and their importance must be recognized by research programs and policy options. (Merryman-East Central)

5451-A3, B1, C2, E2

ANIMAL MANURE MOVEMENT IN WINTER RUNOFF FOR DIFFERENT SURFACE CONDITIONS

Department of Agricultural Engineering, University of Minnesota, St. Paul, Minnesota D.B. Thompson, T.L. Loudon, and J.B. Gerrieh

Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 145-157. 4 tab., 16 ref.

Keywords: Agricultural runoff, Surface conditions, Buffer strip, Slope, Chemical oxygen demand, Nitrogen, Phosphorus, Land application, Soil-water-plant relationships

This study was conducted to examine the quality of winter runoff under various surface conditions and to determine whether a hazard exists due to winter spreading of animal manure. Runoff from manured areas was examined to determine if the nutrient load was significantly different from that of control areas. The influence of a buffer zone on runoff quality downslope from a winter spreading area was observed for three common agricultural field conditions. Grass surface (orchard grass) was selected to simulate effects of winter application on a continuous vegetative cover. Field corn was planted across the slope in 93-cm rows (47,000 plants/ha) in preparation for the other two surface covers. Manure was applied in the spring prior to tillage and planting operations at 34 ton/ha. The corn plot area was sprayed with herbicide prior to corn emergence for weed control. In the fall of the year, the corn was harvested for silage leaving approximately 20 cm of stubble. Four plots were left in this condition. The area was worked over twice, first parallel to the slope and the final time perpendicular to the slope. Each plot was bordered by galvanized sheet metal. The border material was 20 cm wide and placed in the soil vertically 10 cm deep in the soil with 10 cm above the soil surface. Study conclusions were: (1) Nutrient concentrations decrease as runoff water moves downslope from a manured area. (2) Nutrient concentrations contained in runoff leaving a manured area are greatly reduced as the water moves across a 12-m buffer strip. In the study, this was equivalent to a buffer strip equal to one-half of the length of the manured area. The extent to which the buffer area would have to be lengthened for longer manured areas is uncertain. (3) On a sandy loam soil with a 4% slope, a buffer zone 35-m long reduced nutrient concentrations in runoff from manured plots to levels equal to unmanured plot runoff. (4) The overall average nutrient concentration reduction for a buffer zone 12-m long was 62% compared with a 73% overall reduction after a 35-m buffer zone if background concentrations are not subtracted. (5) With background concentrations subtracted, buffer zones removed an average of 82 and 97% of the manure-contributed nutrients from winter runoff with a 12- and 35-m buffer zone. (6) Runoff volumes from manured areas have been shown to be less than from unmanured areas by past researchers. Based on the concentrations reported in

this study and runoff volumes from manured areas less than, or equal to, those from nonmanured areas, nutrient loading rates in winter runoff from manured areas followed by adequate buffer zones should not exceed those from unmanured areas. (7) The quality of winter runoff from unmanured areas was essentially the same for the three surface conditions observed in this study. (Merryman-East Central)

5452-A2, A3, A4, B1, C2

ESTIMATION AND MANAGEMENT OF THE CONTRIBUTION BY MANURE FROM LIVESTOCK IN THE ONTARIO GREAT LAKES BASIN TO THE PHOSPHORUS LOADING OF THE GREAT LAKES

Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada D.W. Draper, J.B. Robinson, and D.R. Coote Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 150-174. 2 fig., 4 tab., 39 ref.

Keywords: Water pollution, Phosphorus, Feedlot runoff, Agricultural runoff, Nonpoint sources, Livestock

The Great Lakes Quality Agreement between the United States and Canada, signed at Ottawa on April 15, 1972, included a recommendation to study pollution of the Great Lakes arising from agriculture, forestry and other land use activities. Accordingly, the International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG) was established in late 1972 and produced a detailed plan outlining an extensive study scheduled for completion in July, 1978. As a major part of the work assigned to the Canadian section of PLUARG, a number of small watersheds representative of larger agricultural regions in Ontario were studied. The purpose of this work was to relate water quality at river mouths to specific land uses and practices in the river basin. Research into the effects of livestock related land uses in these Ontario watersheds was undertaken by several groups. The objective of this study was to derive a numerical estimate of the lake loadings attributable directly to livestock. Of the pollutants of livestock manure origin, the most significant in terms of lake water quality is thought to be phosphorus. To quantify livestock inputs of phosphorus, a simple modeling approach was used based on a synthesis of information on specific livestock management practices and the factors relating these practices to stream loading. This yielded an estimate of about 2,120,000 animal units in southern Ontario producing nearly 22,800 MT of manure-P annually. The present model predicts that 180-570 MT, or 0.7-2.5% of this annual production is loaded directly to streams from feed and barnlots, manure storage areas and winter-spread manure through runoff. This analysis does not include any P loss from cropland receiving manure other than in winter. Elimination of inputs from feedlots and barnlots should decrease livestock inputs of total-P by over 50%. When winter spreading cannot be curtailed, alternatives for ameliorating its effects should be considered. Spreading where buffer strips of perennial vegetation intercede between fields and streams, where drainage enters field sinks, and where crop residues are left on the

land reduces the impact of this practice. Further research on the effects of cattle entering streams should be conducted. (Merryman-East Central)

5453-A2, A3, A4, B1, C2, E2

ESTIMATING PHOSPHORUS LOADING FROM LIVESTOCK WASTES: SOME WISCONSIN RESULTS

Water Resources Center, University of Wisconsin-Madison, Madison, Wisconsin I.C. Moore, F.W. Madison, and R.R. Schneider

Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 175-192. 3 fig., 7 tab., 17 ref.

Keywords: Livestock wastes, Poultry wastes, Water pollution, Phosphorus, Feedlot runoff, Agricultural runoff, Nonpoint sources, Pollution control, Slope, Management

The signing of the Great Lakes Water Quality Agreement in April, 1972 between the United States and Canada signaled the start of a major effort to quantify pollutant loading to the Great Lakes from a variety of differing land uses. The present study was undertaken at the Water Resources Center at the University of Wisconsin-Madison in conjunction with the EPA-sponsored Washington County Project, and IJC-sponsored Menomonee River Pilot Watershed Study. Estimates of loadings from livestock wastes are integral parts of both projects. Attention is focused in this study on the contamination of surface runoff with phosphorus (P) derived from two areas of livestock waste accumulation: barnyards and manure-spread fields. Although additional loadings of manure P result from pastured lands, estimates of loadings from this source are not included in the present study. Annual loadings of total phosphorus to Lake Superior and Lake Michigan from Wisconsin animal waste sources were calculated using critical distances of 100 ft and 400 ft. The percent of all manure P produced by livestock and poultry in the Wisconsin portion of the Great Lakes Drainage Basin predicted to be delivered to Lake Superior and Lake Michigan annually was found to be between 0.8 and 2.5%. Half of the total loading in Wisconsin was found to be associated with dairy barnyards. About 4% of the total manure P loading from the Wisconsin portion of the Great Lakes Drainage Basin is delivered to Lake Superior with the remaining 96% ending up in Lake Michigan. Livestock operations in East Central Wisconsin are responsible for over half of the manure P loading to Lake Michigan. Several recommendations for reducing the total-P loading to the Great Lakes attributable to animal waste sources are suggested by the results of this study. Implementation strategies for animal waste nonpoint source pollution control should be directed at barnyard and feedlot areas first. Clean Water diversion techniques appear to offer promise for reducing nutrient and sediment outflow from these animal concentration areas. Problems arising from the application of animal wastes on frozen ground can be solved either through the provision of adequate waste storage facilities or through the implementation of management guidelines outlining judicious application of wastes on frozen ground. Management strategies for winter application of wastes should include recommended setback distances from any

channel. Also, spreading should be confined to low-slope lands, preferably less than 6%. Lands below steeper slopes should be protected by diversion moving upslope water away. If possible, wastes should be applied on corn fields where the stover has been left. Agricultural statistics at both state and federal levels are production oriented. It is recommended that detailed information on those aspects of agriculture that may have significant environmental impacts be collected in future surveys, most importantly, in the Census of agriculture. (Merryman-East Central)

5454-A3, A4, A8, B1, C2, E2 PHOSPHORUS -- A POTENTIAL NONPOINT SOURCE POLLUTION PROBLEM IN THE LAND AREAS RECEIVING LONG-TERM APPLI- CATION OF WASTES

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Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 193-211. 7 fig., 7 tab., 20 ref.

Keywords: Land application, Animal wastes, Phosphorus, Agricultural runoff, Soil-water-plant relationships, Nonpoint sources, Water pollution

Animal, municipal or agricultural wastes are applied on the land with an objective of either supplying plant nutrients to crops or for disposal purposes. Application rates for crop utilization are usually based on the available N content, thus resulting in higher loading rates of P than plant utilization. Phosphorus applied to the land was assumed to accumulate in the soil through adsorption and formation of insoluble precipitates. However, recent concern about P enrichments in surface runoff water from land receiving wastes raised the question of what effect wastes might have on the behavior of P in the soil-water system. Consequently, surface soil samples were obtained from the soil areas receiving wastes to determine the P behavior in the system. Application of animal wastes increased the water-soluble and dilute acid-extractable P and decreased the sorption capacity of the soils. This resulted in increased levels of equilibrium phosphorus concentration (EPC) in the soil solution. Significant relationships were obtained between EPC of the system and water-soluble and acid-extractable P, expressed by some power function. Continuous application of swine lagoon effluent to a loamy sand beyond the sorption capacity of the soil, resulted in high concentrations of P in the deeper soil layers and surface runoff waters. Before applying wastes to land, serious consideration should be given to the P assimilatory capacity of the soil system without causing high levels of P contribution to the surface waters. (Merryman-East Central)

5455-A4, A9, B1, C2 NUTRIENT AND PESTICIDE MOVEMENT FROM FIELD TO STREAM: A FIELD STUDY

Department of Agricultural Engineering, Iowa State University, Ames, Iowa
J. L. Baker, H. P. Johnson, M. A. Borchert, and W. R. Payne
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 213-245. 10 fig., 7 tab., 21 ref.

Keywords: Water pollution, Agricultural runoff, Nonpoint sources, Erosion, Nitrogen, Phosphorus, Pesticides, Sedimentation

A field study was conducted to provide a better understanding of the relationships between management of farm systems and stream water quality and to enable analysis of such systems using mathematical models. Specific objectives are: (1) to collect data to refine EPA's Agricultural Runoff Model (2) to relate runoff and soil-erosion nutrient (nitrogen and phosphorus) losses to hydrologic factors as altered by land management, (3) to relate losses of pesticides in runoff to pesticide properties and to hydrologic and management factors, and (4) to relate sedimentation to hydrologic and management factors. Eight flow measuring stations were established. Two had H flumes and were planted to corn or beans. One had an H flume and was planted to grass. Three had USGS stations and grew mixed cover. One had a box culvert and grew mixed cover. One had a headwall and culvert and grew mixed cover. Maximum loss from the smaller row-cropped watershed was 5380 kg/ha; maximum sediment loss was 142 mg/kg (1420 kg/ha) for the 50-km² watershed area. Loss from the small grass watershed was low (40 kg/ha) as expected. Sediment concentrations, averaged over a year, ranged from a maximum of 36,360 ppm (corn) to 1350 ppm for the large watershed, and 310 ppm for the grassed watershed. Average concentrations in runoff for single events varied from a maximum of 66,700 ppm for corn to a low of 1800 ppm for grass. Individual samples taken during storm runoff varied from more than 100,000 ppm from row-crop land, 17,100 ppm for the mixed cover large watershed, to 1818 ppm for grass. Sediments transported at all points in the watershed were dominantly in the silt and clay range. High NO₃-N concentrations in Four Mile Creek (average 8.6 ppm, often exceeding 10 ppm) were believed to be the result of high NO₃-N concentrations in shallow subsurface drainage (average of 12.1 ppm). Concentrations of N and P in sediment were usually many times higher than concentrations of dissolved N and P in runoff water. Nutrients associated with sediment, however, either were adsorbed or were part of the organic complex and had limited immediate impact on water quality. Detectable herbicide concentrations in Four Mile Creek were associated with surface runoff events within 6 weeks after application. Losses from cropped watersheds were from 1.5 to 18 times greater than from the watershed as a whole, indicating that attenuation processes were occurring. With the exception of strongly adsorbed paraquat, herbicide losses occurred primarily with runoff water. Losses of most pesticides in common use today, which are not strongly adsorbed to the soil fractions, will not be controlled by erosion-control practices alone. (Merryman-East Central)

5456-A3, A4, B1, C2 THE FATE OF NITRATE IN SMALL STREAMS AND ITS MANAGEMENT IMPLICATIONS

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Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 247-256. 6 fig., 2 tab., 20 ref.

Keywords: Agricultural runoff, Nonpoint sources, Nitrates, Carbon, Soil-water-plant relationships, Denitrification

For some years, a small spring-fed brook (Swifts Brook) has been monitored and laboratory studies on nitrogen transformations in stream-sediment-water systems have been conducted. A preliminary report was made on apparent nitrogen loss during stream transport and on some laboratory studies of the phenomenon. The present paper provides further evidence for significant amounts of nitrogen loss during transport in streams and indicates the stream management options which should enhance the process. Nitrate removal, through denitrification requires an adequate supply of metabolizable carbon for the bacteria involved in the process. Study results indicate that stream denitrification is not very sensitive to carbon content of sediment because the sediments, although causing similar changes in nitrate concentrations of the supernatant, range in loss on ignition from 2.2 to 56%. It seems that the process is limited by the rate at which nitrate diffuses into the sediment rather than by the microbial activity. Nevertheless, the study shows that the rate at which nitrate is removed from water slows down most rapidly over sediments with little carbon. It can be assumed, therefore, that as the carbon content of the sediment falls below some critical level, the denitrification rate will begin to decline. The very high carbon content of Swifts Brook sediment appears to be characteristic of wooded, headwater streams which experience relatively small variation in flow, have relatively poorly defined channels and therefore retain much of the carbonaceous input from the surrounding vegetation. The protection of headwaters against agricultural and other development will help to maintain actively denitrifying sediments in the upper reaches of such streams. Similarly, the establishment of vegetated buffer strips adjacent to downstream channels will tend to increase the carbon inputs to stream sediments. However, while stream bank vegetation ensures a source of carbon for streams, it is likely that the hydraulic factors mentioned above are of major importance in retention of carbon in the stream bed. Thus bank afforestation of some streams in southern Ontario would result in a number of benefits among which are flatter flow peaks, stabilized banks, reduced overland flow inputs from adjacent land, lower water temperatures, a greater diversity of fish species and increased denitrification. However, the cost of the reduced drainage capability which might result may in some cases be so large as to mitigate against this kind of stream management. (Merryman-East Central)

5457-A4, B1, C3, F1, F2 MANAGEMENT AND FINANCING OF AGRICULTURAL BMPs

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Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978

Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 329-340. 2 fig., 1 tab., 5 ref.

Keywords: Water pollution, Nonpoint sources, Best Management Practices, Pollution control, Bacteria, Economics, Legal aspects

One of the major goals of the Section 208 areawide waste management planning program, mandated by PL 92-500 and administered by the Environmental Protection Agency is to develop solutions to identified water pollution problems which can and will be put into practice. The agricultural program developed in SNOMET/King County (Washington) represents one approach to implementing nonpoint water pollution control measures which both satisfies the technical and other requirements of EPA via a water quality management and satisfies the more pragmatic requirements of working farmers who are concerned both about making a living and about conservation. This paper presents the results of that program with special emphasis on unique aspects of the social and political setting of the SNOMET/King County area. Technical work performed during the 208 included an intensive field sampling program to identify the relationship between land use/activities and runoff water quality and a modeling effort which used the field results. The important nonpoint water pollution problems identified were: 1. bacteria, associated with runoff from barn areas and other confined animal areas, 2. bacteria, in some streams, due to animal access to streams and improper management or manure field application. An institutional inventory was conducted early in the 208. The workshops and contacts made during the institutional inventory helped early in the 208 to identify several difficulties or constraints to establishing a workable management strategy. There was a general feeling within the farming community that water quality problems in the Snohomish Basin were not severe and/or were caused by activities other than agricultural. Also, the farming community quite correctly felt that only a few farmers were causing the majority of the problems that did exist. Several basic alternative approaches leading to implementation and use of BMPs were formulated and evaluated during the 208 effort. The alternative chosen was voluntary use of BMPs supported by enforcement action where water quality problems persist. The four programs identified as necessary for meeting this alternative were: (1) education and technical assistance, (2) financing and funding, (3) incentives, and (4) monitoring and enforcement. These are discussed in detail. Implementation of the agricultural nonpoint pollution control program began in late 1977 with funds provided from the initial 208 grant. (Merryman-East Central)

5458-A4, F1 FARM-LEVEL ECONOMIC EVALUATION OF EROSION CONTROL AND REDUCED CHEMICAL USE IN IOWA

Department of Economics, Iowa State University, Ames, Iowa
J. M. McGrann and J. Meyer
Best Management Practices for Agriculture and Silviculture. Proceedings of the 1978 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 359-372. 1 fig., 3 tab., 11 ref.

Keywords: Erosion control, Nonpoint sources, Economics, Model studies, Cost-sharing

This study concentrates on the farm-level economic impact of soil loss control and reduced chemical use. The farms analyzed are typical of three major soil associations in Iowa which cover a wide spectrum of farming conditions in the state. The analysis investigates the impact of restricting soil loss from the present to several reduced levels on net farm income and land rents for both specialized crop and mixed crop and livestock farms. The waste disposal problem of the limited sized livestock enterprises was not addressed in this study. A limited analysis is made of the effect that reducing fertilizer and banning pesticide use would have on farm income as an alternative to reduce nonpoint pollution. Policy alternatives to control erosion, including tax rates to achieve reduced soil loss and cost-sharing schemes for terracing, are evaluated in farm-level models. Consideration is also made as to how information generated in the study can be used for extensionist and farmer training. The procedure used to evaluate the impact of erosion control included the following: (1) Typical or representative farms were identified for each soil association in terms of size and composition of soil types. (2) The universal soil loss equation was used to define cropping and soil management systems that would keep soil loss within defined soil loss limits. (3) Input-output relationships were specified for each cropping and soil management system for the representative farm. (4) Enterprise budgets were developed for each crop with the use of a computerized budget generator and then weighted by cropping required to determine costs and returns by crop rotation and soil management practices. (5) Costs were estimated for the terracing erosion control option. (6) Linear programming models were formulated for each representative farm. The models also incorporated livestock enterprises and labor, machinery and capital costs. (7) Linear programming models were used to analyze impacts of reducing soil loss and other policy parameters. The analysis showed that soil erosion could be reduced below 5 ton/ac, or to a level where productive capacity can be maintained with little or no sacrifice of farm income in two of the soil associations studied. These areas account for over 19 million ac or 28% of the states' land. In the third association, subject to greater erosion problems, reducing soil erosion below 5 ton/ac annually would reduce farm income 30 to 40% resulting in a high farmer and/or public cost. In all soil associations studied, inclusion of livestock enterprises helped to mitigate some of the income-reducing impact of restricting soil loss. (Merryman-East Central)

5459-A3, A4, B1, F1, F2 INSTITUTIONAL AND TECHNICAL ASPECTS OF THE DEVELOPMENT OF AGRICULTURAL BMPs IN A FIVE-COUNTY RURAL/URBAN MICHIGAN REGION

Williams & Works, Inc., Grand Rapids, Michigan
J. P. Jones and J. C. Sutherland
Best Management Practices for Agriculture and Silviculture. Proceedings of the 1978 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 455-462. 2 fig.

Keywords: Best management practices, Agricultural runoff, Nonpoint sources, Water pollution, Legal aspects, Economics

Factors leading to the completed Areawide Waste Management Plan for the Southcentral Michigan Planning Area, and especially those factors which led to development of Best Management Practices (BMPs) for rural and agricultural runoff control, are presented in this paper. A planning team was put together first by creating a Water Quality Commission for overall policy guidance and control, a Technical Advisory Committee comprised of federal, state, county, local and industry technicians and professionals and a Citizens Advisory Committee composed of citizen representatives from the region at large. It was found that annual loadings from urban runoff equal about 2.3 yr of biochemical oxygen demand 7 yr of phosphorus loading. Regional pollution from rural nonpoint sources, under the 1977 state water quality standards, was not found to be very great. Agencies selected to manage rural nonpoint discharge conditions were the counties, mainly because they administer the Michigan Soil Erosion and Sedimentation Control Act which passed in 1972. A uniform method of assessment of the need for BMPs was developed with the help of the Soil Conservation District people on an area by area, farm by farm basis. Briefly, the method consisted of evaluating the kind and magnitude of runoff from each farm within 2 miles of major watercourses. A list of 29 BMPs was composed by the Soil Conservation District people. Unit costs for the BMPs ranged from \$10 for pesticide application, to \$20,000 for a 1.6-ha agricultural waste management system. The U.S. Congress has recently passed legislation to provide needed additional funding to assist individual farmers in implementing the BMPs of the types proposed within the plan. The management plan has been approved at the local level. It is before the State Environmental Review Board and is being reviewed by the Governor's Office for certification. (Merryman-East Central)

5460-A3, A4, B1 THE EVALUATION OF BEST MANAGEMENT PRACTICES FOR THE REDUCTION OF DIFFUSE POLLUTANTS IN AN AGRICULTURAL WATERSHED

Resource Management, Associates, West Chester, Pennsylvania
T. H. Cahill, R. W. Pierson, Jr. and B. Cohen
Best Management Practices for Agriculture and Silviculture. Proceedings of the 1978 Cornell Agricultural Waste Management Conference. Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 485-490. 14 fig., 9 tab., 10 ref.

Keywords: Nonpoint sources, Water pollution, Best management plans, Agricultural runoff, Erosion

The U.S. EPA Nonpoint Source (NPS) model has been calibrated to the Honey Creek watershed, an agricultural area in north-central Ohio. The model was used to estimate the water quality improvement in Honey Creek obtained by the use of no-till row-crop production. This application demonstrated the potential role the NPS model could play in evaluation of cropland management alternatives for federal and state planning agencies concerned with water pollution from

nonpoint sources. However, much work remains to be done to describe other possible BMPs in terms of NPS model parameters before the model can become a flexible planning tool. Perhaps the most convenient format for development and evaluation of management plans is one in which water quality is optimized subject to constraints upon the use of specific management practices on given types of land. Unless there are important interactive effects among agricultural practices at different locations, an "optimal" solution can often be found by disaggregation. Management analysis under Section 208 is frequently described as a straightforward process of evaluating the water quality benefits of a given set of BMPs. However, nonpoint modeling should contribute directly to the formulation of BMPs, since this process must involve implicit or explicit tradeoffs between social costs and water quality benefits. A reasonable procedure may be to establish water quality constraints and then to explore possible management strategies which will achieve the chosen goals. This might be done by developing a series of scenarios, each consisting of a spatially detailed set of management practices which are shown by the model to yield acceptable pollutant loadings. Rather than choosing a "best" plan according to formal criteria, the scenarios could be submitted to policymakers who could then choose on the basis of numerous factors including intuitive judgement. (Merryman-East Central)

5461-A4, B1 ESTIMATION OF AGRICULTURAL NONPOINT LOADS TO THE WAKARUSA RIVER BASIN USING THE "NONPOINT CALCULATOR"

Midwest Research Institute, Kansas City, Missouri
M. J. Davis and J. W. Nebgen
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 525-550. 1 fig., 14 tab., 2 ref.

Keywords: Nonpoint sources, Water pollution, Computer models, Management

The "nonpoint calculator" developed by Midwest Research Institute is a tool for estimating nonpoint loads. The nonpoint calculator is a computerized package of loading functions which can use existing information to estimate quantity of nonpoint loads and the effect of these loads on surface water quality. Output from the calculator can be examined to pinpoint areas of nonpoint problems, and to quantify the severity of each of the many nonpoint sources within an area. Output from the calculator can be used to develop alternatives for managing nonpoint problems to fit the specific needs of particular problem areas. Water quality problems associated with nonpoint pollutants should be alleviated by control or management of the source rather than by a posttreatment after nonpoint loads have caused problems. The nonpoint calculator stresses the source generation of nonpoint loads so that data become available which can be used for control and management of the sources. The calculator can also reduce the different nonpoint loads to a "point" load so that the impact of nonpoint loads on in-stream processes can be estimated. The nonpoint calculator provides a method of readily

accomplishing simple, but tedious calculations and frees the user to address the real issue of nonpoint pollution—what to do to alleviate the problem. (Merryman-East Central)

5462-A4, B1, F1, F2 DEVELOPMENT OF A "208 PLAN" FOR AGRICULTURAL NONPOINT POLLUTION SOURCES IN ILLINOIS

Agricultural Engineering Department, University of Illinois at Urbana-Champaign
D. H. Vanderholm, J. F. Frank, and A. G. Taylor
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 553-580.

Keywords: Nonpoint sources, Water pollution, Best Management Practices, Erosion, Livestock wastes, Pesticides, Fertilizers, Forestry, Fruit production, Legal aspects, Economics

An Agricultural Task Force of 76 members representing various agricultural and environmental groups was formed to assist Illinois Environmental Protection Agency staff in writing the agriculture, forestry and fruit production sections of a comprehensive water quality plan. The task force was divided into six subcommittees which dealt with soil erosion, livestock wastes, pesticides, fertilizers, forestry and fruit production as they are related to water quality. A Problem Assessment, which identified agriculture-related water quality problems in Illinois, was published by the task force in May, 1977. Recommendations were outlined in a Best Management Practices report which was completed in October, 1977. Legal, financial and institutional arrangements for implementing BMPs were proposed in a report completed in February, 1978. The task force will forward its final recommendations to the Illinois Environmental Protection Agency, which will then give consideration to them when they write their state water quality plan. Findings and recommendations of the six task force subcommittees are summarized. (Merryman-East Central)

5463-A4, B1, F1 DEVELOPMENT OF BMPs FOR AGRICULTURE -- NEW YORK STATE STRATEGY

Department of Agricultural Engineering, Cornell University, Ithaca, New York
P. D. Robillard, M. F. Walter, and R. Gilmour
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 581-585. 7 fig., 7 tab., 6 ref.

Keywords: Best Management Practices, Water pollution, Nonpoint sources, Agriculture, Silviculture, Pollution control, Economics

The New York State Department of Environmental Conservation (DEC), Soil Conservation Service, New York State Soil and Water Conservation Committee and the Department of Agriculture and Markets are assisting the planning efforts for water quality management. Cornell University and the Applied Forestry Research Institute at Syracuse are assisting DEC in the development of BMPs (Best Management Practices) to control nonpoint source pollution from agriculture and silviculture. This paper outlines some important considerations and criteria which might be used in developing an agricultural nonpoint source water quality management program. Emphasis should be on practices which manage pollutants at their source and are not capital-intensive structural measures. Also, where the cost of errors in program development is great, stream monitoring may be needed. In addition to EPA guidelines, two aspects of program development which could be emphasized are: (1) The intensity of different agricultural activities on a watershed basis might be used to develop priorities for where and how to begin a nonpoint source control program. (2) Emphasis should be placed on practices which are cost-efficient and of relatively low cost to farmers. The use of farm conservation plans as an implementation vehicle of BMPs is appealing. Benefits include the following: (1) Farm plans allow for a wide range of physical variables and farm management systems upon which the effectiveness of BMPs rely. (2) They provide a sound basis for stage I practices which are essentially good farm management practices. (3) As specific problem pollutants are identified, many of the control practices would exist in farm plans and be familiar to the farm operator. (4) Farm plans are developed and administered by county conservation personnel familiar with farming and farm management systems. (5) If maintained as a farm management tool they provide an opportunity to satisfy the continuous planning requirements on nonpoint source water quality management programs. (Merryman-East Central)

5464-A2, A3, A4, B1 MATHEMATICAL MODELING OF WATER QUALITY EFFECTS OF AGRICULTURAL BEST MANAGEMENT PRACTICES

URS Company, Seattle, Washington
C. Tang
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 625-647. 7 fig., 5 tab., 5 ref.

Keywords: Mathematical models, Model studies, Agricultural runoff, Best Management Practices, Water pollution

This paper is based in part on the report "Water Quality Modeling," a product of the SNOMET/King County 208 Study. The primary objective was to determine the effect of agricultural best management practices (BMPs) on the water quality of the receiving waters. The study area, a large part of the Snohomish River basin, is located in the northwest part of Washington. It encompasses 1200 mi² of drainage area, and the system is formed by two rivers, the Skykomish and Snoqualmie, and an estuary through which the river travels before discharging into Puget

Sound. The objective of this project was to determine the would-be waste load reductions resulting from the implementation of various agricultural BMPs and to predict whether the resultant concentrations in the receiving water would meet imposed water quality standards. An analytical process was utilized which consisted of the following four major steps: (1) inventory of the agricultural practices in the study area, (2) construction of the analytical scheme, (3) determination of the nonpoint waste loads, and (4) simulation of the resultant receiving water quality conditions. Model studies were conducted to accomplish steps (3) and (4). Results of the modeling analysis indicated that a combination of abatement of Everett's combined sewer overflow and application of BMPs to the agricultural waste sources should be sufficient to improve river quality and meet the specified standards during the 7-day, 10-yr low-flow event. (Merryman-East Central)

5465-B1, F1 METHODOLOGY FOR DETERMINING THE OPTIMAL MIX OF BMPs AND AGRICULTURAL PRODUCTION MODIFICATIONS

Department of Environmental Engineering Sciences, University of Florida, Gainesville, Florida

J. P. Heaney and D. C. Ammon
Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 649-664, 17 fig., 1 tab., 11 ref.

Keywords: Model studies, Best Management Practices, Agriculture, Costs, Pollution control

A seven-step graphical procedure was developed to estimate wet-weather pollution control in an urban area. The technique is based on production theory and marginal analysis from economics. Production theory states that a limiting technological relationship, known as a production function, exists between the inputs and outputs of any production process. Marginal analysis simply asks the question—will an action result in a sufficient additional benefit to justify the additional cost? This seven-step procedure can be applied to any mix of control options in series, parallel or both in agricultural areas. The difficult part of the analysis is to derive realistic production and cost functions. Due to the availability of a dairy farm production model, the methodology was applied to a 300-ac (tillable area) dairy farm described by Haith and Atkinson. They presented a linear programming model which allowed determination of the production adjustments that could be made on a dairy farm facing pollution constraints. For this application, production adjustments and a detention basin, excavated downstream on nonillable land, were the options available to the farmer. The least costly solution for controlling 0.3 or less of the sediment washoff was to only use the detention basin. Beyond 30% control the optimal solution was a blend of the two options. Study results thus suggested that savings can be realized by the application of this procedure to agricultural areas faced with a variety of pollution control options. (Merryman-East Central)

5466-A3, A4, B1, C2 MODELING NUTRIENT EXPORT IN RAINFALL AND SNOWMELT RUNOFF

Departments of Agricultural Engineering and Environmental Engineering, Cornell University, Ithaca, New York
D. A. Haith and L. J. Tubbs

Best Management Practices for Agriculture and Silviculture, Proceedings of the 1978 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 1979, p. 665-665, 3 fig., 11 tab., 22 ref.

Keywords: Model studies, Water pollution, Agricultural runoff, Sampling

A research program was designed to refine and test a loading function based on the U.S. Soil Conservation Service's Curve Number Runoff Equation. An earlier study developed the procedure for rainfall runoff. The methodology was extended to snowmelt runoff for prediction and observation of nutrient export from a large (335-km²) watershed. A loading function which multiplies daily runoff by nutrient concentrations and contributing cropped areas was used. Contributing areas were croplands which were unbuffered from stream channels by forest or brushland. Such areas were identified from land use, soils and topographic maps. The loading function relied on readily available data and was computationally straightforward and did not require calibration by water quality sampling. As a minimum, the model testing suggested no evidence that would lead to the rejection of the loading function. It was possible to select watersheds and water quality sampling procedures which would minimize the limitations in model testing. The results of the application of the loading function to Fall Creek was sufficiently promising to establish the value of such further testing. The work is ongoing and future reports will be made. (Merryman-East Central)

5467-B2, C2, D3, E3 CORNELL RESEARCHERS DESIGNING PROCESS TO TURN POULTRY MANURE INTO FEED-STUFF

Anonymous
Feedstuffs, V. 50, No. 47, p. 6, 47, 48, Nov. 13, 1978.

Keywords: Recycling, Refeeding, Poultry wastes, Fermentation, Proteins, Soil conditions

Cornell University researchers have developed two promising waste fermentation processes designed to turn poultry manure into a protein-rich product. Dr. Michael L. Shuler, a faculty member of Cornell's School of Chemical Engineering is developing the single-cell production system in cooperation with Dr. Richard E. Austic, an animal nutritionist, and Dr. Harry W. Seeley, a microbiologist both at the New York State College of Agriculture and Life Sciences at Cornell. The Cornell work represents one of the first attempts to produce microorganisms as a feed by using manure as a growing medium under controlled conditions. The

manure contains a fairly large amount of nitrogen which is one of the main nutrients used by microbes for growth. Bacteria, grown in the waste, are harvested and result in single-cell protein. Dr. Shuler has devised and tested successfully a two-stage conversion process and a single-stage process. The bulk of the waste matter being processed turns into a single-cell product, water and carbon dioxide. After treatment the solid residue which will be less than 5-10% and relatively odorless may be spread on land as a soil conditioner. The production of single-cell proteins from manure appears technically feasible, even though modifications to improve the process should be made. The nutritional value of the bacterial product was evaluated by Dr. Austic. His results showed that the manure-grown product is fairly high in protein content and has an excellent profile of essential amino acids. (Stille-East Central)

5468-B2, C2, D3 CONVERTING MANURE INTO GAS POTENTIAL SOURCE OF ENERGY

S. P. E. Persson and H. D. Bartlett
Energy in Agriculture, V. 26, No. 1, p. 8, Fall, 1978.

Keywords: Slurries, Digesters, Methane, Fuel, Carbon dioxide, Design

Studies were undertaken at Pennsylvania State University in 1974 to develop a practical-sized manure digester system for use under farm conditions. Agricultural engineers, in cooperation with civil engineers and dairy science personnel, built a 3500 cubic feet digester for 50 dairy cows at one of the University stall barns. The digester was fed twice daily at the time of gutter cleaning. After the manure was delivered to the ram type pump with sufficient water to bring the solids content down to about 13% the pump pushed the mixture into the first stage of the digester. The manure was then heated to 96 degrees F by contact with the middle wall. An equal amount of the digester slurry, kept in constant circulation, overflowed from the digester each time it was fed. The material stayed in the digester for 11 to 35 days, depending on the loading rate. A retention time of 5 days gives optimum gas production. Higher loading rates were accompanied by higher daily gas output per unit of digester volume. The biogas, 60% methane and 40% carbon dioxide, produced by the system was used to fuel the Penn State digester. Annually about 25% of the gas produced should be needed for digester heating. On a daily basis from 800 to 2300 cubic feet of gas was used for heating purposes. The digestion process with dairy manure appeared to be stable against minor operational disturbances. However, it is not economically feasible to store large quantities of the biogas. The Penn State studies have provided information on the design, cost, and operation of digester systems for dairy farms which can be useful to farmers. (Merryman-East Central)

5469-A8, B3, C2, D3, E2 COMPOSTING AND PLANT

GROWTH: USE OF CHICKEN MANURE CONTAINING ANTIBIOTICS

H. Vogtmann, W. Obriet, K. Hauser, H. P. Pfirter, and F. Augatburger
Compost Science, V. 19, No. 5, p. 22-25, Sept.-Oct., 1978, 8 tab.

Keywords: Feed additives, Antibiotics, Composting, Crop response, Land application

The influence of Zn-Bacitracin, an antibiotic used in broiler production, was studied in relation to its presence in manure and that manure's effect on plant growth. In the first series of experiments, manure from poultry fed dosages of 0, 20, 50, and 100 ppm Zn-Bacitracin was collected and was mixed at a ratio of 30 kg of excreta to 3 kg of peat for composting. Water was added to bring the moisture content to 80 percent. After the material had been composted over a 4-month period, its effect as a fertilizer on summer barley in a pot trial and on lettuce in a plot trial was tested. Manure from birds receiving Zn-Bacitracin had no discernible effect on the compost process. The highest yield per barley plant was obtained when composted manure was added to the soil, and the lowest occurred in the absence of either compost or fresh manure, despite the presence of identical N, P and K concentrations. However, the presence of Zn-Bacitracin (100 ppm) in fresh manure did have an adverse effect on plant growth. Similar trends were exhibited in the lettuce experiments. In the second series of experiments, Zn-Bacitracin was added directly to the excreta of those chickens that received no antibiotics with their feed. Zn-Bacitracin was mixed first with peat and then was added to bring the concentration of the antibiotic in the excreta to 150 ppm. All other treatments were identical with those given in the first series. The presence or absence of the antibiotic had no significant effect on the key characteristics of the compost product. The composted excreta containing no antibiotic and those containing 150 ppm antibiotic were tested. The composts were worked into the soil of plants pots planted to New Zealand spinach and plot experiments planted to celeriac. Total yields (combined yield of three harvests) of New Zealand spinach and of celeriac were not affected by the presence of Zn-Bacitracin in the excreta. The greater yields obtained with composted manure as contrasted with those with non-composted manure suggests that chicken manure be composted prior to use in vegetable production. (Stiles-East Central)

5470-A8, C3, E2 REMOVAL OF POLLUTION BACTERIA FROM ANIMAL WASTE BY SOIL PERCOLATION

Department of Bacteriology, University of Wisconsin, Madison, Wisconsin 53706
E. McCoy
Paper No. 89-430, American Society of Agricultural Engineers, 1989 Annual Meeting, Purdue University, June 22-25, 1989. 1 tab., 4 ref.

Keywords: Cattle wastes, Bacteria, Land application, Percolation

Fresh bovine manure contains *Escherichia coli* and enterococci in numbers ranging

10⁴/gram and 10⁴ to 10⁶/gram respectively. With manure applications of 5-80 tons/acre, both types of pollution bacteria are removed within the top 14 in. of all loam soil. (McCoy-University of Wisconsin)

5471-A6, B1, F1 OREGON DEVELOPS ODOR DEVICE

Anonymous
Feedstuffs, V. 51, No. 6, p. 22, Feb. 5, 1979.

Keywords: Odor control, Air scrubber, Dusts, Economics

Oregon State University agricultural engineers have invented an "air scrubber" which contains a fan that pulls foul air from inside the barn through a series of air baffles and into a packing chamber filled with flowing water. The water removes dust, odors and some gases before the air passes through a demister and is released outside. In tests, 90% of the dust particles larger than five microns in diameter were removed with the air scrubber. Water used in the system accumulates ammonia and should be put into a septic tank or drainfield, or else could go toward fertilizing plants. The air scrubber would cost about \$100 to add to an existing fan system. (Merryman-East Central)

5472-B2, D3, E2, E3 MINNESOTA DEVELOPS DIGESTER FOR SWINE MANURE

Anonymous
Compost Science, V. 19, No. 4, inside cover, July-Aug., 1978

Keywords: Swine wastes, Recycling, Methane, Pollution control, Odor control, Anaerobic, Digesters, Land application

Research is being done by the University of Minnesota at the Verlo Larson Farm in Anoka County, Minnesota in order to demonstrate the feasibility of integrating a methane-powered electrical generator into an electrical distribution system. System components include a 200-head swine unit, a waste collection tank, digester tank, gas collection unit, motor generator, lagoon, and a series of pumps. Solids from the bottom of the collection tank are mixed and moved to the digester. Volatile solids are broken down biologically, thereby producing gases. Each day hog wastes are pumped into the digester tank and an equal amount pumped out for use on cropland. It is felt that a total waste management system utilizing an anaerobic digester can provide pollution control, odor control, nutrient conservation, as well as produce some energy for use on the farmstead. (Merryman-East Central)

5473-A8, B5, C1, C2 TRANSFORMATIONS OF NITROGEN AND PHOSPHORUS IN

SHEEP FAECES LOCATED IN SALT BUSH RANGELAND AND ON IRRIGATED PASTURE

CSIRO, Division of Plant Industry, Riverina Laboratory, Deniliquin, N.S.W. 2710, Australia

A. J. Rixon and M. Zorin
Soil Biology and Biochemistry, V. 10, p. 347-354, 1978. 9 fig., 2 tab., 21 ref.

Keywords: Sheep wastes, Nitrogen, Phosphorus, Rangeland, Pastures, Arthropods, Mineralization, Dry matter

Sheep faeces enclosed in terylene mesh bags were placed in two contrasting micro-environments within a semi-arid rangeland dominated by *Atriplex vesicaria* Hew ex Benth., and one within an irrigated pasture. Groups of bags were retrieved and their contents analysed at 3-monthly intervals over a total of 20 months. Sheep faeces from semi-arid rangeland and irrigated pastures were used at each site. Irrespective of source, micro-environment, and season, the amount of faecal material remaining on the semi-arid rangeland sites decreased consistently by approximately 2% month. The rate of disappearance for faeces placed under irrigated pastures was 2.5% month. The retention of N in the faeces was proportionately greater than the retention of faecal material. The presence of faecal pellets increased the mineral and total N of the soil beneath bags in the between-bush microenvironment, but not the mineral-N content beneath bags placed under bushes of *A. vesicaria* in semi-arid rangeland. After 20 months, the proportion of total and inorganic P remaining in the faecal material placed under bushes was 50 and 40% respectively, and in faecal material placed between bushes the corresponding figures were 30 and 20%. More Truog "available" P accumulated in soil under bags placed between bushes than under bags placed below bushes. The amount of total and inorganic P remaining after 20 months in the faecal pellets on the irrigated pastures was 20 and 10% respectively. The small loss of organic P from the faecal material indicated an absence of mineralization. (Rixon-Riverina Laboratory)

5474-A11, C3 SEROTYPES OF *ERYSIPELOTHRIX RHUSIOPATHIAE* ISOLATED FROM SWINE AND FROM SOIL AND MANURE OF SWINE PENS IN THE UNITED STATES

National Animal Disease Center, Federal Research, Science and Education Administration, U.S. Department of Agriculture, Ames, Iowa 50010
R. L. Wood and R. Harrington, Jr.
American Journal of Veterinary Research, V. 39, No. 11, p. 1833-1841, Nov., 1978, 8 fig., 7 tab., 39 ref.

Keywords: Swine wastes, Serotypes, Animal health, Pathogenicity

Serotypes of 1,527 isolants of *erysipelo-thrix rhusiopathiae* from porcine tissues from various parts of the United States and of 166 isolants of the organism from soil and manure of swine pens in Iowa were determined. Serotypes 1 (subtypes 1a and 1b), 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, and N were found in porcine tissue collected over a 6 3/4-year

period. Serotypes 1, 2, 5, and 6 were the most prevalent (36.2%, 41.2%, 9.0%, and 3.7%, respectively). The 11 other serotypes composed 6.4% of the isolants. The relative frequency of isolation of the 4 most common serotypes was generally similar in different regions of the United States and during different years. Serotypes 1 (subtypes 1a and 1b), 2, 3, 4, 5, 6, 8, 9, 10, and N were found in samples of soil and manure collected from swine pens over a 6-month period. The relative frequency of isolation of serotypes 1, 2, 5, and 6 was similar to that of the serotypes found in swine. The serotypes of 3.5% of the isolants from swine and 1.2% of the isolants from soil or manure could not be determined by the use of antisera and reference strains representing known serotypes of *E. rhusiopathiae*. Selected isolants of serotypes other than serotypes 1 or 2 from swine were tested for pathogenicity in mice and swine. All isolants tested were pathogenic for mice, and 1 or more isolants of serotypes 3, 4, 9, 10 and 11 were pathogenic for swine. (Wood-USDA)

5475-B3, C2, E3 MULTIELEMENT ANALYSIS OF ANIMAL FEED, ANIMAL WASTES, AND SEWAGE SLUDGE

Division of Chemistry and Physics, U.S. Food and Drug Administration, Washington, D.C. 20204
S. G. Caper, J. T. Tanner, M. H. Friedman, and K. W. Boyer
Environmental Science & Technology, V. 12, No. 7, p. 785-790, July, 1978. 1 fig., 3 tab., 28 ref.

Keywords: Refeeding, Animal wastes, Sewage, Sludge, Chemical analysis, Heavy metals, Trace elements, Toxic minerals

Animal excreta and sewage sludge are currently being used as animal feed ingredients on an experimental basis. The levels of 30 elements are reported for a typical cattle feedlot diet, two dried cattle manures, a commercial cattle waste product, two dried poultry manures, and a metropolitan sewage sludge. The analyses are conducted using neutron activation analysis, induction coupled plasma spectroscopy, atomic adsorption spectroscopy and anodic stripping voltammetry. The levels of most inorganic elements are considered higher in animal wastes and sewage sludge than in traditional animal feeds. For most elements the levels determined by several techniques are in good agreement. Problems of loss of lead with precipitate formation, accurate quantitation of elements present at high levels, and obtaining homogeneous samples for analysis are discussed. (Caper-USDA)

5476-A6, B2, E2 A PLOW-DOWN METHOD FOR RAPID COVER OF LIQUID MANURE

Engineering Research Service, Research Branch, Canada Agriculture, Ottawa, Ontario, Canada
M. Feldman and F. R. Hore
Canadian Agricultural Engineering, V. 13, No. 2, p. 65-68, Dec., 1971. 5 fig., 3 tab., 2 ref.

Keywords: Slurries, Land application, Odor control, Plow-cover system

In response to odour problems resulting from conventional methods of spreading liquid manure from confined housing for animal production, a rapid plow-cover system was devised at the Canada Department of Agriculture, Animal Research Institute farm. Simple hoods are fitted to the rear outlets of vacuum, liquid manure tankers to direct the slurry downward and spread it over a width of about 50 to 60 inches (1.27 to 1.52 metres). A second tractor with wheels set 60 inches (1.52 metres) apart, inside measurement, and towing a 4-bottom, 16-inch (40.6-centimetre) moldboard plow (84-inch (1.62 metre) width of coverage) follows immediately behind the tanker to plow down the manure. Inversion of the furrow slices completely buries the manure, resulting in little odour from the disposal operation. Three of four tankers may be used with one plow, resulting in a high capacity system. Use of 3-inch (7.6 centimetre) tanker outlets, reduction of tanker pressure through reduced tractor pto speed, and operation at ground speeds of 4 to 5 miles per hour (6½ to 8 kilometres per hour) resulted in reasonable application rates. (Feldman-Canada Agriculture)

5477-A10 BIOLOGICAL AND ECOLOGICAL INVESTIGATIONS OF HORN FLIES IN CENTRAL TEXAS: INFLUENCE OF OTHER INSECTS IN CATTLE MANURE

Entomology Research Division, Agricultural Research Service, USDA, Kerrville, Texas 78028
R. R. Blume, S. E. Kunz, B. F. Hogan, and J. J. Matter
Journal of Economic Entomology, V. 63, p. 1121-1123, 1970. 1 fig., 1 tab., 11 ref.

Keywords: Cattle wastes, Flies, Insects

Cattle droppings exposed to insect activity for 5 minutes produced significantly greater numbers of *Haematobia irritans* (L.) than droppings exposed for 30 minutes or for 2, 4, 6, and 24 hours. There was a significant negative correlation ($r=0.9^*$) between the mean numbers of horn flies and the mean numbers of insects of other species produced per dropping during the 6 time intervals studied. (Blume-USDA)

5478-A2, B2, B4, B5, E2 HOW TO WIN WITH A RUNOFF SYSTEM

L. Marshall
Dairy, V. 35, No. 4, p. 16, Feb., 1979.

Keywords: Feedlot runoff, Dairy wastes, Lagoons, Design, Slope, Land application

Dale Pline, a dairyman living near Nampa, Idaho, set up a dairy waste system years before it became an economic and government-mandated necessity. The system has proven such a workable design that it has been copied many times. One of the main

factors responsible for the system's effectiveness is its slope—a 6 ft. drop per 100 ft. over about ¼ of a mile with a live creek at the bottom. The system consists of two catch basins in the corrals, connected to a lagoon system by underground pipe. The two catch basins are 4 ft. sections of concrete tile pipe, set up on end. The diameter is 4 ft., and each is covered by a protective grate. The bottoms are cemented in, and a 12 in. pipe at the bottom drains down the slope to the lagoon system. The two lagoon system consists of a 50,000 gallon dirt pond which settles out the solids, while the liquids pass on through to a 450,000 gallon second stage pond. The first pond is pumped out once a year by Pline, who then takes it to his nearby crop fields. Water from the large pond is used as needed and mixed with regular irrigation water for use on crops. The system has a year round workability. Pline's system originally cost \$10,000 and would cost double that today. (Stiles-East Central)

5479-B3 COVERED PIT CUTS HOG MANURE ODOR

Staff Editor, Hog Farm Management
K. Brown
Hog Farm Management, V. 16, No. 3, p. 32, 34, March, 1979. 2 fig.

Keywords: Odor, Swine wastes, Confinement building, Design, Scraping, Manure pit

Harold Fischer, a Fulda, Minnesota pork producer, has cut odor in his 824-hog capacity modified-open-front finishing unit by covering his manure pit with precast concrete slabs. He installed 2 scrapers on top to run the wastes through 3 slots into the pit. The pit runs the length of the building and is 196 ft. long and 12 ft. wide. The cover on the pit is 9 in. below the slats leaving room for the scrapers to run. Fischer says feed efficiency has been improved and the facility is easier to keep warm in the winter. (Stiles-East Central)

5480-B2, B4, E2 PUMP 'N' GO DISPOSAL FOR PORTABLE HOUSES

Anonymous
Missouri Ruralist, V. 119, No. 21, p. 31, Dec., 1978. 2 fig.

Keywords: Swine wastes, Design, Manure pit, Land application

Brothers Martin and David Wagner worked with Extension agricultural engineer Jerry Carpenter to design their farrowing and pit system for their hogs. Seven-foot-wide hog houses and pens were set on 10-foot centers, leaving a 3-foot aisle between each house. A 3 by 3½ ft. manure pit extends the length of the unit. Wooden slats in the aisles between pens are not fastened to allow easy access to pit. Finished slot width within the pens is expected to be about 1 inch, allowing pigs to easily pull legs out should they slip through. The pit is pumped twice in November and April. (Stiles-East Central)

5481-A11, B3, E3
MICHIGAN FINDS NO HAZARD
IN DEHYDRATED POULTRY WASTE

Anonymous
 Feedstuffs, V. 50, No. 49, p. 14, 16, Nov. 27, 1978.

Keywords: Refeeding, Poultry waste-dried, Performance, Meat quality

Steers averaging 709 lb. were assigned according to weight and breed to 2 groups of 4 animals each. They were fed a corn silage ration supplemented with either soybean meal or dried poultry waste. All steers were housed in individual metabolism stalls throughout the study. During the 180-day study, 2.95 tons of dried poultry waste were fed to the 4 experimental steers, equal to 14.8 tons of wet, caged layer waste (assuming a 20% dry matter). The dried poultry waste was produced for about \$40-45/ton (drying and no value on waste); with the labor cost it would be about \$72/ton. Study results revealed no deleterious effects on animal performance or carcass traits. (Merryman-East Central)

5482-A7, C3
BACTERIA IN THE AIR OF HOUSED SWINE UNITS

U.S. Department of Agriculture, Agricultural Research Service, Lincoln, Nebraska 68503
 L. F. Elliott, T. M. McCalla, and J. A. Dehazer
 Applied and Environmental Microbiology, p. 270-273, Aug., 1978. 4 tab., 9 ref.

Keywords: Air pollution, Swine waste, Bacteria, Staphylococcus, Salmonella, Fecal coliforms

Two housed, swine-growing-finishing units were studied for numbers of total bacteria, fecal coliforms, Staphylococcus, and Salmonella in the air. At 20.5 and 122 cm from the floor, total colony-forming particles, as tested, averaged 3.4×10^4 and $1.3 \times 10^9/m^3$ of air, respectively; whereas fecal coliform counts averaged 24×10^3 and $1.9 \times 10^3/m^3$ of air, respectively. Only 41% of the organisms growing on Staphylococcus 110 medium tested as Staphylococcus. Of 458 Staphylococcus isolates, 5 were coagulase-positive. No Salmonella were detected in the air of the units tested. (Elliott- USDA)

5483-B2, F1
SIZING OF LIQUID MANURE TANK WAGONS AND THE ECONOMIC EVALUATION OF LIQUID MANURE INJECTION

Agricultural Engineering Department, University of Illinois, Urbana, Illinois
 J. N. Scarborough, E. C. Dickey, and D. H. Vanderholm
 Transactions of the ASAE, V. 21, No. 6, p. 1181-1184, Nov.-Dec., 1978. 5 fig., 2 tab., 4 ref.

Keywords: Land application, Equipment-land application, Soil injection, Economics, Liquid wastes

For each size of livestock operation, a least-cost manure tank wagon can be selected. Primary factors affecting the optimum selection are annual manure volume to be hauled, hauling time, and purchase price of the tank wagon. If timeliness is a factor, or if the optimum size tank wagon is not available, selecting a larger size wagon does not appreciably change the annual cost. Two major factors affecting the cost of an injection system are retail price and the annual hours of in-soil use. Injection cost can be recovered through decreased nitrogen volatilization losses since injection has a lower volatilization loss than does surface spreading. At current nitrogen prices, injection of liquid manure can be economically justified for many livestock operations. Odor control was not assigned a monetary value, but would be an added benefit with injection. (Scarborough-University of Illinois)

5484-B2, C2, D3, E3, F1
MOBILIZATION AND IMPACTS OF BIO-GAS TECHNOLOGIES

International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria
 J. K. Parikh and K. S. Parikh
 Energy, V. 2, p. 441-455, 1977. 4 fig., 11 tab., 12 ref.

Keywords: Recycling, Methane, Biogas plants, Economics, Animal waste, Agricultural waste, Fertilizers, Nitrogen

Consideration is given to the possibility of utilizing animal and agricultural waste in biogas plants to produce methane gas and fertilizer. India is used as a case study. The possibility of extending this idea not only to other developing nations but also to developed countries such as the United States is presented. The economic benefits to a family using a biogas plant and the impact of its widespread acceptance on a national scale are evaluated. To realize the potential of biogas fully, village plants of about 200 m³ capacity for approximately 100 families would be needed. The impact of full-scale adoption of biogas plants in India could mean that, by 2000 AD, almost 90% of the rural energy requirements of the domestic sector could be met; at present, this accounts for about 45% of the total energy consumption in India. Sanitation would be improved also. (Merryman-East Central)

5485-A11, B3, E3, F1
ENSEILED MANURE -- A PROFITABLE MIX FOR GEORGIAN

D. Foster
 Calif News, V. 16, No. 11, p. 14, 32, Nov., 1978. 1 fig.

Keywords: Refeeding, Cattle waste, Ensilage, Performance, Meat Quality, Economics

Sam Hay, a Covington, Georgia cattle man, claims that livestock feeders can hedge against future cattle price declines by setting up programs now to feed ensiled manure based rations with a savings of up to 20% over their current feed costs. Hay's waste handling system calls for manure to be collected regularly from the feedlot floor, mixing it with cracked corn, corn silage and/or some form of

chopped forage, and ensiling the mixture for at least ten days before feeding. Hay recommends feeders utilize a mix of 40% fresh manure (20% DM), 45 percent cracked corn (90% DM), and 15% corn silage (80% DM) to make up a complete finishing ration. He states that dry brood cows can be maintained on a mixture of about 90% ensiled manure and 10% chopped forage, including such row cropping cast offs as corn stalks. Carcass quality from cattle receiving these waste-supplemented diets is very good. (Merryman-East Central)

5486-B3, C1, C2, C3, D3
BEEF WASTE MAY BE LEAST SUITABLE FOR ENSELEMENT

Anonymous
 Feedstuffs, V. 51, No. 4, p. 26-27, Jan. 22, 1979. 1 tab.

Keywords: Ensilage, Cattle waste, Swine waste, Poultry waste, Nitrogen, Crude protein, Ether extract, Ash, Fiber, Coliforms, Bacteria

A study was conducted to determine and evaluate changes which occur in nutritive composition, nitrogen distribution, fermentation parameters and microbiological populations when various livestock wastes are ensiled with corn. The cattle waste used was from a steer being fed a corn silage-soybean meal ration; the swine waste was from grower pigs fed a standard corn-soy diet, and the poultry waste was from caged layers also on a corn-soy diet. Levels of waste incorporated into the corn for ensiling (53% cattle, 23% swine and 16% poultry) were based on the nitrogen content of the respective waste. The wastes and corn were mixed, packed into laboratory silos, evacuated with carbon dioxide and ensiled. The silos were opened and contents were analyzed after 42 days. Crude protein was evaluated at 13.5, 27.2, and 38.5% for cattle, swine and poultry, respectively. Ether extract was 2-4 times higher in poultry waste than in the other wastes. Bulkiness and low nitrogen content of the cattle waste made it a less advantageous medium for ensiling. There were no differences between the control and cattle waste-treated silages for in vitro digestibility. There was a significant 6% increase with the addition of the swine waste, and a 12% increase with poultry waste. A second study evaluated microbial changes using only swine and poultry wastes. The waste was collected from the same sources, and again mixed with chopped corn plant and packed into laboratory silos. Silos corresponding to 0, 1, 2, 4, 8, 16, and 37 days of ensiling were analyzed for microbiological changes. Coliforms were found in greater numbers in poultry and swine waste ensilements than with the control. However, by day 4 coliform counts were zero except for the swine waste silage. (Merryman-East Central)

5487-A9, A11, B1
COCCIDIOSIS IN TURKEYS: EVALUATION OF INFECTION BY THE EXAMINATION OF TURKEY BROILER LITTER FOR OOCYSTS

Houghton Poultry Research Station, Houghton, Huntingdon Cambs, PE17 2DA, England
P. L. Long and B. J. Millard
Avian Pathology, V. 6, p. 227-233, 1977. 2 tab., 8 ref.

Keywords: Animal health, Poultry litter, Coccidiosis, Drugs

Three hundred and ninety-six litter samples were taken from turkey broiler houses on four British farms. The samples were examined during a period of 2-10 weeks from the time day-old poulters were placed in the houses. Oocyst numbers were low at 2 weeks, reached a peak at 4 weeks and then rapidly declined by 8 weeks in poulters that had been treated with sulphamonomycin and 3-nitro-4-hydroxyphenylarsonic acid. In monensin-treated turkeys, oocyst numbers in litter were low at 2 and 4 weeks, reached a peak at 6 weeks and then rapidly declined. Samples from monensin-treated turkeys yielded significantly lower numbers of oocysts. While there was no difference in the food conversion ratio of poulters given the different treatments, monensin-treated birds marketed at 11-13 weeks, 15-16 weeks, and 21-24 weeks were 3.0%, 4.8%, and 3.3% heavier respectively than birds treated with sulphamonomycin and 3-nitro-4-hydroxyphenylarsonic acid. (Merryman-East Central)

5488-A2, B1, B2, B3, D3, E2, F2, F4

ALTERNATIVE METHODS FOR HANDLING AND DISPOSAL OF BEEF FEEDLOT WASTES

Agricultural Engineering Department, Oklahoma State University, Stillwater, Oklahoma
A. F. Butchbaker
Unpublished paper, American Society of Agricultural Engineers, Stillwater, Oklahoma, October 30, 1970, 22 p. 7 fig., 4 ref.

Keywords: Cattle wastes, Feedlots, Management, Design, Legal aspects, Solid wastes, Slurries, Feedlot runoff, Land application

The design of a beef feeding facility should include the waste management system as an integral part of the design. It should initially be thought of as an expense devoted to running the enterprise. The waste management system depends not only upon whether it is an open feedlot or a confinement building but upon many other factors. Many of these factors depend upon local conditions. Local topographic influences, local soil conditions, availability of materials and labor, and weather related variables are just a few of the variables that may influence the choice and design of a beef waste management system. (Butchbaker-OSU)

5489-A11, B3, C2, D2, D3, E3 ENSILING CHARACTERISTICS, DIGESTIBILITY AND FEEDING VALUE OF ENSILED CATTLE WASTE AND GROUND HAY WITH AND WITHOUT SODIUM HYDROXIDE

Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
W. D. Lamm, K. E. Webb, Jr. and J. P. Fontenot
Journal of Animal Science, V. 48, No. 1, p. 104-110, Jan., 1979, 8 tab., 28 ref.

Keywords: Cattle wastes, Ensilage, Waste, Sodium hydroxide, Waste treatment, Sheep Refeeding, Cattle, Performance

The feasibility of ensiling 60% cattle fecal waste obtained from cattle fed a 70% concentrate diet with 40% ground grass-legume hay, wet basis, (27% waste and 72.4% hay, dried basis), and treating the mixture with sodium hydroxide (NaOH) prior to ensiling was investigated. Mixtures were ensiled with levels of 0, 20, 4, 8 and 12% NaOH, dry basis, in small laboratory silos. Fermentation characteristics, as measured by pH and lactic acid production were most favorable ($P < .01$) at the 0 and 2% NaOH levels. Acetic acid production was highest ($P < .01$) in the 4, 8 and 12% NaOH-treated silages. *In vitro* dry matter digestibility (adjusted for NaOH content) was intermediate between that of the control and high NaOH-treated silages. Sixteen wethers were used in a metabolism study to evaluate the untreated and treated wastelages. Treatment with NaOH enhanced ($P < .05$) the apparent digestibility of dry matter, organic matter, crude fiber and NFE and nitrogen retention. Total sodium excretion was higher ($P < .01$) for lambs fed treated wastelage. Approximately 4% of the sodium ingested as NaOH was retained in lambs fed treated wastelage. A cattle growth study was conducted to determine the effect of NaOH treatment (4% dry basis) upon the palatability of ensiled cattle manure and hay (wastelage). Dry matter intake was similar for calves fed either treated or untreated wastelage, but was lower than intake for calves fed the corn silage control ration. Ensilage cattle waste with grass-legume hay after treating the mixture with NaOH improved both *in vitro* and *in vivo* dry matter digestibility, although dry matter intake was decreased when fed to growing calves, compared to a corn silage control ration. (Lamm-Virginia Polytechnic Institute and State University)

5490-B2, B3, B4, B5, C2, D3, E2, F1

HANDLING OF MANURE FROM DIFFERENT LIVESTOCK AND MANAGEMENT SYSTEMS

University of Illinois at Urbana-Champaign, Urbana, Illinois 61801
D. H. Vanderholm
Journal of Animal Science, V. 48, No. 1, p. 113-120, Jan., 1979, 8 tab., 8 ref.

Keywords: Animal wastes, Land application, Fertilizer value, Nitrogen, Waste treatment, Waste storage, Economics

The relationship of manure value to manure management system is discussed. Liquid manure systems and bedded manure systems tend to minimize nitrogen losses and maximize fertilizer value. In contrast, systems with anaerobic lagoons lose large quantities of nutrients although this may even be an advantage if the land area available for spreading is limited. Incorporation of the manure soon after spreading was assumed for every system. Liquid manure systems tend to be more expensive than the other systems

compared. The fertilizer value is also greater from liquid manure systems, but the additional return is not large enough to overcome the extra cost. (Vanderholm-University of Illinois at Urbana-Champaign)

5491-B4, B5, C2, E2, F1 PLANT NUTRIENT AND ECONOMIC VALUE OF ANIMAL MANURES

USDA, SEA-AR, Southern Piedmont Conservation Research Center, Watkinsville, Georgia
S. R. Wilkinson
Journal of Animal Science, V. 48, No. 1, p. 121-133, Jan., 1979, 2 fig., 6 tab., 65 ref.

Keywords: Animal wastes, Nitrogen, Phosphorus, Potassium, Fertilizer value, Economics, Waste storage, Land application methods, Economics

Animal manures have economic value as plant nutrient sources and as amendments for soils whose physical properties can be improved by adding organic matter. Their value as fertilizer per metric ton applied is generally inverse to their water and carbon contents. Plant nutrient concentrations in animal manures are highly variable, thereby introducing uncertainty into meeting plant nutrient needs for crop production. Where manure has been applied for several years, however, little or no additional fertilizer phosphorus (P) and potassium (K) are needed for crop production. Animal manures were ranked in decreasing order as to replacement fertilizer value (dollars) as follows: broiler litter; hen litter; hen droppings; beef feedlot; swine and dairy solid manure; poultry slurry; and other classes of livestock manure slurries. Storage conditions and degree of dilution mainly determine the fertilizer value of liquid manure. Liquid manures have little potential economic value as fertilizer outside the farm where produced. Relative efficiencies of manure nitrogen (N) as compared to commercial fertilizer N range from less than 30% to greater than 100%. Manure N applications that are immediately incorporated have produced yields equal to those produced by fertilizer N for many different crops. The representative plant nutrient contents selected from the literature suggest that replacement fertilizer value can exceed waste management costs, thus changing manure from a waste to a resource. (Wilkinson-USDA, SEA-AR, Southern Piedmont Conservation Research Center, Watkinsville, Georgia)

5492-A1, A4, A8, B1, B5, C2, C3, E2

MANAGEMENT RESTRICTIONS IN SOIL APPLICATION OF MANURE

University of California, Riverside, California 92521
P. F. Pratt
Journal of Animal Science, V. 48, No. 1, p. 134-143, Jan., 1979, 7 fig., 1 tab., 50 ref.

Keywords: Animal wastes, Pastures, Crop-lands, Land application, Fertilizer value, Soil amendments, Environmental effects, Water pollution, Soil-water-plant relationships, Salts, Nitrates, Pathogens

The nature of manures and the factors that present management restrictions on applications of manure to lands are discussed. Because manures are low-grade fertilizers and/or soil amendments that have various quantities of water and nutrients, depending on the species of animal, the ration and on management of the manure after it is produced, general management recommendations have little meaning. Pathogens do not present restrictions on amounts of manures used when manure is incorporated into the soil on cropped lands but can limit the amounts used on pastures when surface applied. Crop yield reductions present serious limits for crops because of salt effects. Excess NO_3 in pasture and forage crops can limit the rate of application. Water quality degradation not only restricts the amounts of manures added but also the time of application and the condition of the land at time of application. Accumulations of mineral elements that decrease the general physical and chemical quality of the soil as a medium for plant growth can also limit the total amount of manures added to a land area. Because of the many factors involved, meaningful recommendations can only be developed for the manures, the crops, the soils, and climate and other pertinent factors, such as water quality objectives and problems in a local area or region. (Pratt-University of California)

5493-A11, B1, C1, C2, E3 NUTRITIONAL AND ECONOMIC VALUE OF ANIMAL EXCRETA

Feed Energy Conservation Laboratory, Physiology and Genetics Institute, SEA
L. W. Smith and W. E. Wheeler
Journal of Animal Science, V. 48, No. 1, p. 144-156, Jan., 1979. 13 tab., 76 ref.

Keywords: Animal wastes, Poultry litter, Poultry wastes-dried, Refeeding, Economics, Performance, Nitrogen, Crude protein, Calcium, Phosphorus, Magnesium, Potassium, Crude fiber

Animal excreta products contain 48 to 73% TDN, 20 to 31% crude protein, 13 to 20% crude fiber, 9 to 8.6% calcium, 1.6 to 2.5% phosphorus, 4 to 9% magnesium, and .5 to 2.3% potassium. The products range in value as sources of plant nutrients from \$24 to \$39 per metric ton of dry matter. Their value as a feedstuff ranges from \$113 to \$173 per metric ton when soybean meal cost \$221 per metric ton of dry matter and \$116 to \$254 when soybean meal cost \$369 per metric ton of dry matter. In both nutritional and economical terms, poultry litter had the highest value and cattle excreta the lowest. The nutrient content of animal excreta and constraints placed on the computer program limited their use from 15 to 34% of the total dietary dry matter for selected classes of ruminants. Constraints on the computer program met or exceeded the nutrient requirements established by the National Research Council. The computed value of the excreta products when soybean meal cost \$221 or \$369 had little effect on the level used in diets for lactating cows or finishing steers. In production trials, animals have performed satisfactorily on diets containing animal excreta and thus evidence of their value as feed ingredients has been provided. However, valid nutritional compositions of excreta products are essential to formulate balanced diets, and the resulting diets must be consumed by the recipient species at levels to achieve desired levels of production. (Smith-USDA)

5494-B2, C1, C2, C3, D1, D2, D3, E3 PROCESSING AND HANDLING OF ANIMAL EXCRETA FOR RE- FEEDING

University of Illinois, Urbana, Illinois 61801
D. L. Arndt, D. L. Day, and E. E. Hatfield
Journal of Animal Science, V. 48, No. 1, p. 157-162, Jan., 1979. 5 fig., 2 tab., 20 ref.

Keywords: Refeeding, Livestock wastes, Drying, Composting, Ensililing, Chemical treatment, Aerobic treatment, Waste treatment, Separation techniques, Single cell proteins, Nitrogen, Nucleic acids

The feeding of nutrients contained in animal excreta is the most valuable use of these recoverable resources. Utilizing animal excreta as feed nutrients can alleviate pollution problems, decrease feed costs and increase the supplies of available nitrogen and essential mineral sources. Ruminants appear to be the ideal target animals for the practice of refeeding processed animal excreta. Due to their symbiotic relationship with the microflora occupying the rumen, they can utilize fiber, nonprotein nitrogenous compounds (NPN) and nucleic acids to a greater extent than nonruminants. This paper reviews the "state of the art" of collecting, processing and incorporating excreta into the diets of livestock (mostly ruminants). It briefly covers the most commonly used methods of processing animal excreta, including: drying, composting, ensiling, chemical treatment, aerobic treatment production of single cell protein (SCP), and liquid-solid separation. It also reviews work related to the losses of essential nutrients in animal excreta. Animal excreta must be harvested frequently after disposition to reduce protein equivalent losses, i.e., volatilization and leaching of nitrogen. Animal excreta must be processed to improve animal acceptability, destroy pathogens, and reduce odors. Incorporating processed animal excreta into the diets of ruminants is advantageous to the economic production of beef as well as being a reliable pollution control measure. (Arndt-University of Illinois)

5495-B1, C2, D3, E3 USE OF ANIMAL EXCRETA FOR MICROBIAL AND INSECT PRO- TEIN SYNTHESIS

U.S. Department of Agriculture, Beltsville, Maryland 20705
C. C. Calvert
Journal of Animal Science, V. 48, No. 1, p. 178-191, Jan., 1979. 1 fig., 13 tab., 68 ref.

Keywords: Animal wastes, Algae, Yeast, Fungi, Houseflies, Earthworms, Protein synthesis, Refeeding, Substrates, Nitrogen

A number of systems in which algae, yeasts, bacteria, fungi, insects and earthworms are used for the conversion of animal excreta nitrogen to protein have been reviewed. The technical aspects of the various systems used, the nutritional value of the product produced, and the practicality of the proposed systems for protein production have been discussed. Currently, none of the systems reviewed contribute greatly to the supply of protein supplements for livestock feeds. However, the algal systems have received the most attention and have produced the most promising results. In the algal systems, the

amount of nitrogen converted to protein is as great as or greater than that of any of the other systems; the protein quality, in terms of the amounts that can be used by animals, is high. The systems in which yeasts, bacteria, and fungi are used all show promise in the conversion of animal excreta nitrogen to protein, but little published data critically evaluating the systems are available. However, the fact that these micro-organisms grow on a variety of manurials suggests that animal excreta may be a suitable substrate for protein production. Houseflies and earthworms grown on animal excreta appear to represent a source of protein suitable for use by livestock and poultry. However, these invertebrates do not convert inorganic forms of nitrogen to protein but, rather, extract protein from excreta and thereby make it more available and acceptable to other animal species. Low protein yields and problems concerned with maintenance of large populations of insects and earthworms for inoculation of excreta limit the practical application of these systems at present. (Calvert-USDA)

5496-B2, C2, C3, D3, E3 MICROBIAL METHANE PRO- DUCTION--THEORETICAL AS- PECTS

University of Illinois, Urbana, Illinois 61801
M. P. Bryant
Journal of Animal Science, V. 48, No. 1, p. 193-201, Jan., 1979. 3 fig., 3 tab., 46 ref.

Keywords: Animal wastes, Fermentation, Methane, Anaerobic, Bacteria, Recycling

The methane fermentation involves bacteria which obtain energy for growth by catabolizing anaerobically degradable organic matter to the end-products CO_2 and CH_4 . Three metabolic groups of bacteria are involved. Fermentative bacteria hydrolyze materials such as lipids, protein, and polysaccharides and ferment most products with excretion of acetate and other saturated fatty acids, CO_2 and H_2 as major endproducts. A second group of mainly unknown species, the H₂-producing acetogenic bacteria, produce acetate and H_2 from endproducts of the first group. The methanogenic bacteria catabolize the endproducts, mainly acetate, CO_2 and H_2 produced jointly by the other two groups, to the terminal products. Reasons for the importance of the maintenance of a very low H_2 concentration in the ecosystem by the methanogens for the efficient regulation of product formation such as maintaining low propionate and other reduced product formation and high acetate and H_2 formation by the fermentative bacteria and its necessity for catabolism of fatty and probably aromatic acids to acetate and H_2 are discussed. The stoichiometry, kinetics of growth and environmental factors affecting the efficiency of the fermentation are briefly discussed. (Bryant-University of Illinois)

5497-B2, D3, E3, F1 EXPERIMENTAL METHANE PRODUCTION FROM ANIMAL EXCRETA IN PILOT-SCALE AND FARM-SIZE UNITS

Iowa State University, Ames, Iowa 50011
R.J. Smith, M.E. Hein, and T.H. Greiner
Journal of Animal Science, V. 48, No. 1, p. 202-217, Jan., 1979. 6 fig., 7 tab., 27 ref.

Keywords: Anaerobic, Digesters, Livestock wastes, Methane, Construction methods, Slurries, Economics, Recycling

The forms of anaerobic digester that have been used in municipal waste treatment are described. The expected energy output from mesophilic (35°C) digesters fed livestock manure is assessed. Daily gas production of between 1.1 and 1.5 m³/m³ day per unit liquid volume of the digester is expected. On-farm storage of digester gas is not regarded as practical, and immediate use in an engine generator is recommended. It is expected that 18% of the gas energy could be recovered as electrical energy and that 56% could be recovered as thermal energy. A digester may be integrated into a system of hydraulic manure handling because most manures will require dilution before digestion. An analysis of the energy required to heat the slurry from a cold, confinement barn for beef cattle shows that some form of influent-to-effluent heat exchanger is necessary if surplus heat is to be available during cold weather. Heat losses from above-ground digesters may be reduced to negligible proportions with 75 to 150 mm of good insulation. Mixing requirements are discussed at some length; it is concluded that intermittent pulses of high intensity are desirable. The performance of a hypothetical digester for 250 beef animals is assessed and compared with published data. A simple economic analysis of the cost of generating 1 kWh is developed by using the 250-head beef model and published construction costs. If heat production is assessed at one-eighth the value of electrical power, then a farm digester of about 100 m volume could produce electricity for about \$12/kWh. The paper concludes with a brief discussion of some engineering problems that may be encountered if thermophilic digestion were employed. (Smith-Iowa State University)

5498-E3 ALTERNATIVES IN ANIMAL WASTE UTILIZATION-- INTRODUCTORY COMMENTS

Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
J. P. Fontenot
Journal of Animal Science, V. 48, No. 1, p. 111-112, Jan., 1979. 4 ref.

Keywords: Animal wastes, Recycling, Refeeding

About 50% of the animal waste output is produced in confinement and is collectable. A number of alternatives are available for utilizing the wastes. These are: (1) Sources of plant nutrients, (2) Feed ingredients for farm animals, (3) Substrate for microbial and insect protein synthesis, and (4) Substrate for methane production by microorganisms. The purpose of this Symposium is to evaluate the relative value of the different kinds of wastes for these alternate methods of utilization. In the evaluation, all aspects need to be considered, including cost, economic value, problems, hazards, etc. In some cases, perhaps a particular kind of waste at a location could be used for more than one purpose. The important consideration is to maximize the economy of safe utilization of these wastes. (Merryman-East Central)

5499-A9, A11, A12, B1, D1, D2, D3, E3 HUMAN AND ANIMAL HEALTH ASPECTS OF FEEDING LIVESTOCK EXCRETA

Auburn University, Auburn, Alabama 36830
T. A. McCaskey and W. B. Anthony
Journal of Animal Science, V. 48, No. 1, p. 163-177, Jan., 1979. 13 tab.

Keywords: Animal wastes, Refeeding, Animal health, Public health, Pathogens, Heavy metals, Copper, Drugs, Hormones, Pesticides, Waste treatment

During the last 15 years, many animal feeding trials have been performed which demonstrated the feed value of livestock wastes (particularly for ruminant animals). Although animal wastes have been satisfactorily used in blended rations for animal production without apparent harmful effects to animals or humans, the practice of feeding waste is currently not sanctioned by the Food and Drug Administration because wastes may contain agents hazardous to humans and animal health. Possible harmful agents would include pathogenic microorganisms and chemical residues such as arsenic, antibiotic and drug residues, hormones, pesticides, and heavy metals. Processing animal wastes by heat, chemical treatment, and fermentation all show potential for killing pathogenic organisms. Oxidation ditch treatment is not always so successful. Potential health problems appear to be of minor importance since processing the wastes eliminates many of the potential hazards. The only reported health problem associated with feeding waste occurred with ewes fed broiler litter containing high copper levels. This hazard can be eliminated by close monitoring of copper levels in rations for sheep. Some states currently have, or are developing, guidelines to permit the use of animal waste as a feed ingredient. Although studies have demonstrated that refeeding animal wastes can be safe, additional research is needed to demonstrate safety from potential health hazards that have not been previously evaluated. (Merryman-East Central)

5500-B1, E3, F2 REGULATORY CONSIDERATIONS IN THE USE OF ANIMAL WASTE AS FEED INGREDIENTS

Food and Drug Administration, 5600 Fishers Lane, Rockville, Maryland 20857
J. C. Taylor and R. E. Geyer
Journal of Animal Science, V. 48, No. 1, p. 218-222, Jan., 1979.

Keywords: Animal wastes, Refeeding, Legal aspects

This paper discusses the responsibilities of the United States Food and Drug Administration (FDA) and of state governments with respect to the use of animal waste as an animal feed ingredient. The Food and Drug Administration's jurisdiction over the regulation of animal waste, past actions taken by the FDA and several other federal agencies, and proposed action being considered by the FDA are presented. State regulations with respect to refeeding are reviewed along with the relationship between the federal and state programs. (Merryman-East Central)

5501-A4, B1, F2 UPDATE OF NATIONAL AND STATE PROGRAMS PRESENTLY UNDERWAY TO CURB POINT AND NONPOINT SOURCES OF WATER POLLUTION FROM ANIMAL PRODUCTION FACILITIES

Environmental Protection Agency, Washington DC 20460
D.F. Smith
Journal of Animal Science, V. 48, No. 1, p. 223-227, Jan., 1979. 5 fig., 1 tab., 2 ref.

Keywords: Water pollution, Point sources, Nonpoint sources, Legal aspects, Feedlots, Confinement pens

P.L. 92-500, The Federal Water Pollution Control Act Amendments of 1972, has provided two mechanisms for the control of water pollution from animal production facilities. Point source controls require that confined animal production facilities apply for a NPDES permit in order to operate. Nonpoint source controls, as established by state and area-wide water quality management programs, are to be developed around the concept of "Best Management Practices". Point and nonpoint sources of pollution are defined and discussed. (Merryman-East Central)

5502-B1, E3, F1, F2 SUMMARY AND GENERAL EVALUATIONS

Arizona Feeds, Tucson, Arizona 85703
B. P. Cardon
Journal of Animal Science, V. 48, No. 1, p. 228-233, Jan., 1979. 7 tab., 7 ref.

Keywords: Animal wastes, Legal aspects, Recycling, Economics

Animal agriculturists today operate in a world of many and complex government regulations. The Food and Drug Administration, Environmental Protection Agency and Occupational Safety and Health Administration all have some say in how agricultural waste is to be handled and used. There still exists a feeling in the public mind that animal waste is dangerous to man just because it is a waste product. The inference is also made that the unfavorable and "filthy" characteristics of animal wastes, if fed to animals, will be translated to the meat or byproducts of the animals fed. The attitude is unfortunate because animal waste per se is no more harmful and has no greater impact upon the animal than any other ingredient. Nutrients or toxic materials in animal waste can be determined. Animal wastes currently have a true value of something less than \$20 a ton rather than the \$50 to \$200 often quoted. The latter values result when "add-on" costs are computed into the price to cover treatment needed to prepare the material in a form suitable for use, and to transport it to the use site. (Merryman-East Central)

5503-A5, A8, B2, C2, C3, D3 OVERLAND RECYCLING SYSTEM FOR ANIMAL WASTE TREATMENT

Animal Science Department, Alcorn State University, Lorman, Mississippi 39096
H. E. Grier and W. C. Burton
Environmental Protection Agency Report EPA-600/2-79-029, Jan., 1979, 71 p. 14 fig., 42 tab., 37 ref.

Keywords: Waste treatment, Overland spray, Swine wastes, Lagoons, Aerobic, Anaerobic, Feedlot runoff, Sampling, Soil-water-plant relationships, pH, Chloride, Coliforms, Biochemical oxygen demand, Nitrogen compounds, Land application

Twelve 6 x 6 meter plots were designed to receive overland spray or rainfall only and sloped to direct runoff via plastic lined runoff ditches to one cone shaped plastic lined corner of each plot. These plots were completely randomized over all treatments, each treatment having four replications. Treatments consisted of tap water, tap water and aerobic effluent, and aerobic effluent applied so that all plots received equal volumes of overland spray within each of three periods. Periods one, two and three proved 1x, 2x, and 3x as much of the applications on all plots than before treatments. Soil and soil water samples from all plots were analyzed for pH, chloride, $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-N}$, conductance, coliform, and BOD₅. These parameters were statistically analyzed according to a completely randomized block design and the means separated for significance using DMRT. Reduction or increase in principal parameters of concern were noted, as well as response of edible crops to various treatment. (Grier-Alcorn State University)

5504-A8, B3, C2, E2 INORGANIC NITROGEN AND SOLUBLE SALTS IN A DAVIDSON CLAY LOAM USED FOR POULTRY MANURE DISPOSAL

Bunda College, Malawi
R. R. Weil, W. Kroontje, and G. D. Jones
Journal of Environmental Quality, V. 8, No. 1, p. 86-91, Jan.-March, 1979. 2 fig., 5 tab., 25 ref.

Keywords: Land application, Poultry wastes, Crop response, Soil chemistry, Denitrification, Salts, Ammonium, Nitrates, Nitrites

The logistics of handling poultry manure often dictate that it be spread on land near to its source at rates far in excess of what would constitute its efficient use as fertilizer. This study measured, at various times during the growing season, the concentrations of soluble salts, ammonium, nitrates, and nitrites in the upper horizons of a common Piedmont soil which had received yearly up to 100 metric tons of poultry manure for 5 years. During spring and summer, concentrations of soluble salts (up to 4,064 ppm) and nitrite-N (up to 60 ppm) were high enough to be toxic to corn (Zee mays, L. cultivar 'Pioneer 3368A'). Ammonium-N was detected at up to 800 ppm in April, but decreased to less than 100 ppm by July. Both stand establishment and subsequent growth of corn were very poor on the heavily manured plots. As seedlings, corn plants on these plots exhibited burned leaf tips and margins and stunted root growth associated with high levels of ammonia, nitrites, and total soluble salts. Severe moisture stress was evident throughout the growing season due to the effects of salinity and stunted root systems. Rapid leaching of salts and nitrates did not take place until after

September. Denitrification appeared to be responsible for some losses of nitrates. Despite the accumulation of nitrites, especially in May and July, most probable number determinations failed to show any consistent inhibition of the populations of *Nitrosomonas* and *Nitrobacter*. (Weil-Bunda College)

5505-A5, B2, C2, C3 POLLUTANT MOVEMENT TO SHALLOW GROUND WATER TABLES FROM ANAEROBIC SWINE WASTE LAGOONS

Department of Agronomy, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
T. G. Ciravolo, D. C. Martens, D. L. Hallock, E. Collins, Jr., E. T. Kornegay, and H. R. Thomas
Journal of Environmental Quality, V. 8, No. 1, p. 126-130, Jan.-March, 1979. 6 tab., 12 ref.

Keywords: Groundwater pollution, Swine wastes, Anaerobic, Lagoons, Fecal coliforms, Chlorine, Copper, Manganese, Ammonium, Nitrates, Phosphate, Zinc, Trace elements, Seepage

The effect of three anaerobic swine waste lagoons on ground water quality was investigated in the Atlantic Coastal Plain region. The lagoons studied were located on high-water-table soils with different textures. Ground water was sampled from wells, with unperforated casings, located at depths to 6 m and distances to 30 m from the lagoons. These samples were taken monthly from September 1974 through January 1975, and bimonthly thereafter through November, 1975. Ground water also was sampled in November 1975 from shallow wells with perforated casings located at distances to 36.6 m from two of the three lagoons. Constituents determined to investigate ground water contamination were density of fecal coliforms and concentrations of Cl, Cu, Mn, $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$, $\text{PO}_4\text{-P}$, and Zn. Chloride, $\text{NH}_4\text{-N}$, and $\text{NO}_3\text{-N}$ concentrations in ground water samples indicated that seepage entered ground water from each of the three lagoons. Rupture of lagoon seals leading to seepage was attributed to drying of exposed subsoil or embankment soil during recession of lagoon liquid levels and to gas release from microbial activity in soil beneath the seal. Overall, a low level of ground water contamination occurred around a lagoon that was in operation for over 8 years in Myatt very fine sandy loam with a clay subsoil, and a lagoon that was in operation 1 mo prior to this investigation in Dragston fine sandy loam with a sandy clay loam subsoil. Ground water contamination in excess of recommended drinking water standards for Cl and $\text{NO}_3\text{-N}$ occurred around the third lagoon. This lagoon was in operation for more than 8 years in a disturbed area consisting of predominantly sandy surface and subsurface soil. Ground water contamination in the embankment area of this lagoon was attributed to seepage and beyond the embankment area to ground water contamination from lagoon overflow. (Ciravolo-VPISU)

5506-A6, B3, D1, E3 HIGH TEMPERATURE DRYING OF ANIMAL WASTE

School of Engineering, University of Guelph, Guelph, Ontario N1G 2W1
A. G. Meiering, F. B. Heese, L. A. Rudgers, and J. Walker
Canadian Agricultural Engineering, V. 17, No. 2, p. 75-80, Dec., 1975. 6 fig., 2 tab., 19 ref.

Keywords: Dehydration, Odor control, Poultry wastes, Refeeding, Fertilizers, Economics, Design

A pilot scale, odor-free waste drying system consisting of a continuous flow drying unit, afterburner and heat exchanger was developed and its performance analyzed at the Waste Research Station of the University of Guelph. The exhaust air from the drier entered an afterburner, where odoriferous compounds and dust were oxidized by open flame combustion at 650° C. Complete odor elimination, except for traces of ammonia, was achieved in the drying of poultry manure. Nearly 60 percent of the heat supplied for this process was recovered by heat exchanger for the drying, which required about 1,200 kilocalories per kilogram of water evaporated. Temperatures and moisture contents of the drying air and the waste materials were monitored at different locations within the system. These values could also be predicted as functions of distance travelled in the drier through a computer simulation of the heat and mass transfer phenomena. Theoretical and experimental data agreed well. The dried products can be used as feed components for ruminants or as fertilizer. The drying costs of poultry manure can be recovered through sales returns as animal feed costs savings. Drying of poultry manure also competes well with other treatment methods. (Meiering-University of Guelph)

5507-A11, B1, E3 ORGANOLEPTIC, CHEMICAL AND BACTERIAL CHARACTERISTICS OF MEAT AND OFFALS FROM BEFF CATTLE FED WET POULTRY EXCRETA

Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada, N1G 2W1
O. B. Smith, G. K. MacLeod, and W. R. Ueborne
Journal of Food Protection, V. 41, No. 9, p. 712-716, Sept., 1978. 5 tab., 33 ref.

Keywords: Refeeding, Poultry wastes, Beef quality, Cattle

Three groups of growing-finishing beef cattle were fed soybean meal, urea or acetic-propionic acid-treated wet-cage layer excreta as a protein supplement for 125 days. Rib-roasts from the cattle were evaluated for cooking loss, juiciness, flavor, tenderness and overall acceptability. Rib cuts were analyzed for moisture, fat and protein, and samples of the liver, heart, kidney, and longissimus muscle were analyzed for cadmium, lead, copper, iron, calcium and phosphorus. In addition, gall bladders and mesenteric lymph nodes obtained from the cattle at slaughter as well as layer excreta samples were cultured for salmonellae. No significant differences were found in any of the factors studied. Salmonellae were isolated from the cage layer excreta, but not from cattle tissues. Apparently, feeding organic acid-treated wet cage layer excreta to cattle would not affect the nutritive value, organoleptic quality or wholesomeness of beef. (Smith-University of Guelph)

5508-A6, B3, C1, C2, C3, D2, E3
A LABORATORY EVALUATION OF ORGANIC ACIDS AND FORMALDEHYDE AS PRESERVATIVES FOR WET CAGE LAYER EXCRETA INTENDED FOR RECYCLING BY FEEDING TO LIVESTOCK

Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario N1G 2W1

O. B. Smith, C. A. Fox, D. N. Mowat, G. K. Macleod, and E. T. Moran
Canadian Journal of Animal Science, V. 58, No. 2, p. 209-216, June, 1978. 5 fig., 2 tab., 25 ref.

Keywords: Poultry wastes, Refeeding, Odor control, Coliforms, Salmonella, Nitrogen, Mold, Waste composition, Chemical preservatives

A previous study on the feeding value of wet cage layer excreta (CLE) indicated the need of a chemical preservative to stabilize CLE and control odor. An acetic-propionic acid mixture, formaldehyde, and an acetic-propionic acid-formaldehyde mixture were evaluated as preservatives during a 28-day storage period. Two-kilogram amounts of 3-day-old CLE were treated with the three chemicals each at 0.25% (low rate), 0.50% (medium rate) and 1.0% (high rate) wt./wt. Each excreta sample was inoculated with 5×10^6 *Salmonella infantis*/g. All treatments were replicated twice and stored uncovered at 22°C. Discoloration, mold growth and putrefaction as well as changes in pH, dry matter, total nitrogen, ammoniacal nitrogen and volatile fatty acid content of samples taken at 0, 7, 14 and 28 days after treatments were the criteria of evaluation. Total *Coliform* count and *Salmonella* recovery were also recorded. The acetic-propionic acid mixture appeared most effective in retarding physical deterioration, especially mold growth and discoloration. All three chemicals were equally effective ($P > .05$) in reducing nitrogen losses. A level $\times$ time interaction effect ($P < .05$) was obtained for all parameters. Compared to the control, the medium and high rates of treatment effectively retarded deterioration for 7 and 14 days, respectively. The rise in pH, nitrogen losses, ammoniacal nitrogen and butyric acid content of samples treated at the medium and high rates were lower ($P < .05$) than for the control, and spoilage was less extensive. Beyond 14 days, spoilage and nitrogen losses were similar ($P > .05$) to that observed in the control. The low treatment rate was in general ineffective in preventing spoilage and nitrogen losses. Total *Coliform* counts decreased with time, and *Salmonella* recovery was nil from 7 days postinoculation for all treatments including the control. (Smith-University of Guelph)

5509-B1, C2, F1
INFLUENCE OF RATION GRAIN CONTENT ON COST OF FEEDING, MANURE HANDLING AND STORAGE AND MANURE CRED-IT

Department of Animal Husbandry, Michigan State University, East Lansing, Michigan
 H. D. Woody and J. R. Black
 Research Report 353, Michigan State University Agricultural Experiment Station, Sept., 1978, p. 234-237. 10 ref.

Keywords: Cattle, Rations, Feedlots, Economics, Management, Waste composition, Nitrogen, Phosphorus, Potassium

The influence of ration grain content on housing, feeding, labor and manure handling costs is summarized for a two-year feedlot trial. Additionally, the value of the manure credit is estimated. The values are based upon slatted floor housing and a calf feeding program 450 to 1050 pounds. As the total grain in the ration (including the corn in the corn silage) increased from 30 percent to 100 percent, there was a decrease in the amount of manure (.72 cu. ft. vs. .37 cu. ft.), a reduction in pit depth (8.60 ft. vs. 4.90 ft.) per head capacity and in manure handling cost per head (\$8.87 vs. 5.96). Total cost for manure handling (5.08¢ vs. 2.83¢ per day) and for feeding (4.20¢ vs. 1.87¢ per day) was lower for the high grain ration. The manure credit was 4.08¢ per day for the high silage ration vs. 2.87¢ per day for the high concentrate ration. The net cost per day (total cost less manure credit) was 4.71¢ per day higher for the steers fed the high silage ration (\$18.09¢ vs. 13.38¢). The difference between an all silage ration, silage containing 50 percent grain, and a ration containing 70 percent corn-30 percent silage was 3¢ per day. (Woody-Michigan State University)

5510-A11, B1, C2, D3, E3
NEW MANURE PROCESSING UNIT FOR INDIVIDUAL FARMER INTRODUCED

Anonymous
Feedstuffs, V. 50, No. 49, p. 45, Nov. 27, 1978.

Keywords: Digesters, Recycling, Single cell protein, Methane, Sheep, Performance

Southwestern Porcelain, Inc. of Sand Springs, Oklahoma is introducing a manure processing unit for confinement operators with at least 100 dairy cows, 200 beef cattle or 1,000 feeder pigs. The company's president says that this is the first really practical manure digester for the individual farmer. The unit will produce enough 28% protein supplement to feed about twice as many animals as the number of animals supplying manure to the unit. The single cell protein residue from the unit has an amino acid content comparing favorably with alfalfa and soybean meal. Daily gains of sheep fed a ration containing digester residue were tested as comparable with sheep receiving soybean meal as protein supplement. The unit, Sestator ProThane Generator, should pay for itself in 5-10 years depending on the degree of utilization of the methane gas and the single cell protein feed produced. (Stille-East Central)

5511-A9, A10, B1, D2
A FEED ADDITIVE TO CONTROL FLIES IN POULTRY MANURE

Departments of Dairy and Poultry Sciences and Entomology, Kansas Agricultural Experiment Station, Kansas State University, Manhattan, Kansas 66506
 A. W. Adams, M. E. Jackson and C. W. Pitts
Poultry Science, V. 58, p. 2001-2003, 1978. 2

tab., 5 ref.

Keywords: Fly control, Poultry wastes, Feed additives, Methoprene

To determine methoprene's effect on fly emergence from poultry manure, 18,000 8-wk-old caged pullets were fed continuously 10 gm. of methoprene per ton of feed 42 days. Hatch mates (13,500) in an adjacent, similarly constructed and equipped house were fed untreated feed. Data on fly emergence were recorded twice a week after counting average numbers of flies in fly traps, in buckets of manure, and on fly strips and spot cards. Differences between average counts in the treated and control groups were significant by each of the four data-gathering methods. The methoprene reduced fly emergence by 77.0% in manure buckets, 65.5% in fly traps, but increased fly emergence 19.2% on fly strips, and 92.2% on spot cards. We attribute the increases in fly counts by the latter two counting methods in the treated house to migration of flies from adjacent untreated houses. (Adams-Kansas State University)

5512-A11, B3, E3
THE POTENTIAL HAZARD OF LIVESTOCK WASTE RECYCLING. I. PERFORMANCE AND CARCASS EVALUATION

Michigan Department of Animal Husbandry, Michigan State University, East Lansing, Michigan
 M. T. Yokoyama, L. R. Shull, C. J. Flegal, W. T. Magee, J. H. Kinzall, and J. R. Anstead
 Research Report 353, Michigan State University Agricultural Experiment Station, Sept., 1978, p. 226-280. 3 tab., 4 ref.

Keywords: Refeeding, Poultry waste-dehydrated, Cattle, Performance, Carcass quality

Steers were fed corn silage, supplemented with either soybean meal or dehydrated poultry waste (DPW) in balanced rations for 180 days. Except for a moderate diarrhea during the last month of the feeding study as a result of burning the DPW, there were no clinical signs of a detrimental effect, nor were there any gross signs of pathology at slaughter. Animal performance and carcass traits were not significantly different between the steers fed either the control or DPW rations. (Yokoyama-Michigan State University)

5513-B2, B3, B4, F1
HANDLE MANURE AS A SOLID, SEMISOLID OR LIQUID?

M.F. Brugger
Hoard's Dairyman, V. 123, No. 22, p. 1344, Nov. 25, 1978. 2 fig.

Keywords: Waste storage, Dairy wastes, Liquid wastes, Solid wastes, Semisolid wastes, Design, Economics

When selecting a type of waste storage, all manure to be handled on the farm should be considered. Factors influencing storage type include: (1) whether water from the milk house or parlor are added, (2) soil type, (3) depth to groundwater and location of bedrock, and (4) state or local regulations. Capacities of

solid manure storage areas should be based on at least 1.5 cubic feet of manure per 1,000 pounds animal weight each day. Additional capacity equal to one-half the volume of bedding used should be added. Liquid runoff from solid storage should go to a sodded waterway or retention pond for disposal at a later time. Solid manure storage permits use of one manure handling system for the whole farm. Semisolid manure results when only a small amount of bedding is used. Earthen basins with a picket dam generally are used for semisolid manure storage. With proper design and construction, aboveground structures made of post and plank or reinforced concrete may be used. Semisolid manure storages should be designed to keep runoff water away from the structure. Rain and melted snow in the area may be removed through the picket dam or prevented with a roof. Drainage should be directed to a detention pond or allowed to flow across a grass filter bed or other disposal area. Semisolid manure storage is usually a lower cost storage for free stall manure than liquid systems. It also may mean one type of manure handling equipment will be sufficient. Capacities of semisolid manure storages also are based on 1.5 cubic feet of manure per 1,000 pounds of dairy cow weight, plus one-half the volume of bedding used. Detention pond size is based on precipitation falling on an area equal to maximum surface area of semisolid storage. Liquid manure is that which has water added at the manure pump. Liquid storage systems offer the advantage of storing both the milking center wastewater and barn manure together. The waste can be handled easily by pump which may reduce labor in some cases. It can be injected directly or plowed into the soil to improve use of nutrients and reduce odor, although this does add to the cost. Of the three types, liquid manure storage is 3 cubic ft/day for a 1,400-pound cow. The wastes can be stored in tanks under the barn or in below ground concrete tanks located outside the barn. Above-ground silo storages may be used where soil precludes other types but they are expensive. (Merryman-East Central)

5514-A8, B5, C2, E2 FERTILIZER DEALER PROMOTES MANURE'S VALUE IN GROWING CORN

Anonymous
Beef, V. 15, No. 6, p. A-14-A-15, Feb., 1979. 2 fig.

Keywords: Swine wastes, Cattle wastes, Fertilizers, Land application, Nitrogen, Phosphorus, Potassium

George Van Houten, a Washington, Iowa fertilizer dealer works closely with livestock farmers in utilizing fully their cattle and hog manure to fertilize cornland and reduce the need for commercial fertilizer. Van Houten realizes that farmers are going to utilize their livestock wastes on fields anyway, so he helps them utilize the waste and fertilizers together to keep the proper nutrient balance for good crop yields. Van Houten's manure program is simple. He keeps a three-ring binder of information on each customer. Included are farm and field maps. Each field is keyed and a record is kept on how much manure and how much liquid commercial fertilizer are applied. Fields are soil-sampled regularly so that Van Houten and his customer know levels of nitrogen, phosphorus and potassium present. When a customer wants to haul manure, he calls Van Houten and asks which field it would

be best to spread on. The dealer checks his records, noting particularly phosphorus build-up, and suggests a field and a manure application rate. No special charge is made for the service. (Merryman-East Central)

5515-B1, F1 FEATURES, COSTS OF DIFFERENT TYPE SLATS

P. Queck
Wallaces Farmer, V. 104, No. 4, p. 120-121, Feb. 24, 1979. 3 fig.

Keywords: Slatted floors, Economics, Durability

Slats come in many sizes, shapes, materials and costs. Wood slats are the most popular for use in farrowing houses. They are warm and the most comfortable. However they wear rapidly, especially when wet. Life expectancy is between 2 and 4 years. They also are hard to clean, can harbour bacteria, and may warp. Cost runs \$2 to \$4 per sq. ft. Concrete slats are durable and intermediate in cost. They are not as warm as wood or plastic and they are hard to clean. Concrete can be abrasive to legs and knees. These slats are especially popular for finishing and gestation facilities. Their cost varies roughly from \$2.25 to \$2.80 per sq. ft., depending on type and size. Plastic slats are corrosion resistant and also warmer than concrete and metal. They clean readily and do not absorb moisture, but they are slippery when wet. Price ranges from \$3.50 to \$6 per sq. ft., or more, depending on style and span involved. Fiberglass slats are warmer and not as slippery as metal slats. However, they become slick when wet. Because they are relatively new, life expectancy has to be considered speculative. Cost of these slats run between \$4 and \$8 per sq. ft. Steel slats are colder than wood, plastic, fiberglass, or concrete. They are slippery when wet and susceptible to rust (except for certain stainless and porcelainized steels). Steel slats clean easily and will not harbour bacteria. Prices for steel vary as to quality. They run from \$6 per sq. ft. for regular steel to \$10 per sq. ft. for stainless. (Merryman-East Central)

5516-C2, E2 CHEMICAL ANALYSIS

North Carolina State University, Raleigh, North Carolina
M. R. Overcash, D. L. Reddell and D. L. Day
Paper No. 74-4546, American Society of Agricultural Engineers, 1974 Winter Meeting, Chicago, Illinois, Dec. 10-13, 1974, 36 p. 1 fig., 17 tab., 9 ref.

Keywords: Chemical analysis, Animal wastes, Chemical oxygen demand, Total organic carbon, Nitrogen, Phosphorus, Economics, Quality control

Analyses for chemical oxygen demand, total organic carbon, forms of nitrogen, and forms of phosphorus are detailed with regard to variability, costs, quality control, intermethod comparison, and test adaptations or improvements. (Overcash-North Carolina State University)

5517-B2, C2, D3 DESIGN CRITERIA FOR GRASS FILTER AREAS

Division of Soil and Water Districts, Ohio Department of Natural Resources, Columbus, Ohio 43224
D. A. Norman, W. M. Edwards, and L. B. Owens
Paper No. 76-2573, American Society of Agricultural Engineers, 1976 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1976, 7 p. 1 fig.

Keywords: Design, Grass filters, Biochemical oxygen demand

The grass filter design criteria in the Ohio Livestock Waste Management Guide are based on making travel time proportional to BOD concentration. Factors considered are the number and weight of animals, the feedlot cleaning frequency, the feedlot area that is uncovered, and the watershed area above the grass filter. Climatic factors are not considered as parameters because the farmer has no control over them. It is assumed that settleable solids are removed before the runoff reaches the grass filter. Grass filter length, width and slope are dependent variables. The criteria, which have been accepted for use in Ohio by the Cooperative Extension Service, the Soil Conservation Service, the Ohio Environmental Protection Agency, and by the Ohio Department of Natural Resources are based on experience with trial designs starting in 1969. Early results from a research project designed to test the criteria are discussed. (Merryman-East Central)

5518-A1, B1, C2, D3, E2, E3 THE HANDLING OF NITROGENOUS WASTES IN RURAL INDIA

T. S. Rao
Ambio, V. 6, No. 2-3, p. 134-136, 1977. 1 fig., 1 tab., 13 ref.

Keywords: Organic wastes, Agricultural wastes, Animal wastes, Human wastes, Waste disposal, Waste composition, Land application, Recycling, Biogas, Algae

This article deals with nitrogenous wastes disposal in rural India. These wastes include agricultural, animal and human wastes. Since nitrogenous wastes supply the basic nutrient for the survival and spread of various bacterial, protozoal, helminthic and other pathogenic organisms, both in the soil and water phases of the environment, careful management of such wastes is needed, not only to substantially reduce disease and disability problems, but also for conservation and optimum utilization of nitrogen. Proper handling of nitrogenous wastes will have to be considered, not only to generate wealth from such harmful wastes but also to ensure the protection of the health of villagers and their livestock. Reuse of nitrogenous wastes by adoption of the appropriate technology relevant to the socioeconomic conditions of the people are discussed. (Merryman-East Central)

5519-A8, B2, E2 LIVESTOCK MANURE CREATES A TEXAS MIRACLE

B. Fleming
Beef, V. 15, p. A22-23, Jan., 1979. 2 fig.

Keywords: Land application, Cattle wastes, Crop response, Reclamation

Joe Weatherly, president of Beef Cattle Company, discovered that land that had been "cotton farmed to death" could be made into highly productive grazing land. Applying 20 to 40 tons of feedlot manure per acre and irrigating it with center pivot systems brought about this miracle. Mr. Weatherly's goal is to upgrade the land so that it will produce 1,000 pounds of beef per acre per year. Weatherly's formula is simple—smooth off the land and if it's practical, add an irrigation well. Then work into the top three or four inches of soil about 40 tons of manure. Weatherly double-crops the land, planting Hay-Grazer (a commercial sorghum-sudan hybrid) in early June and wheat in May. Using this double-crop system, Weatherly says it is entirely possible to get 250 days of grazing each year. In addition to the manure applications, Weatherly adds 80 pounds of commercial nitrogen per acre the first year. That is all the fertilizer that is used until the third year of grazing, when he goes back with about a 10-ton application of feedlot manure. Weatherly feels that with this kind of grazing operation, manure can be one of the most profitable items produced in the feedyard. (Merryman-East Central)

5520-B2, C2, D3, E3 HERE'S THE SECRET TO KIND THOUGHTS ABOUT HOG MANURE

Anonymous
Successful Farming, p. H13, March, 1977. 1 fig.

Keywords: Digesters, Swine wastes, Economics, Design, Recycling, Methane

Jim Fischer and co-workers at the University of Missouri have built what they are calling the first successful, completely automated manure digester that is integrated into a hog farm. It could produce methane gas worth \$3,000 or more per year. The digester consists of 2 structures. One is the belowground settling tank which eliminates some of the liquid. Wastes at 1-3% solids are regularly flushed from buildings into this tank. A 6% waste is achieved in the settling tank and is pumped daily into the digester structure which is a sealed concrete tank, sized to accommodate the volume of manure anticipated. The structure is surrounded by a metal bin which has foam insulation between it and the concrete to prevent heat loss. The digester, which went into operation last September, cost \$25,000. Some experts have said a methane generator of this type will pay when gas costs \$5 per thousand cu. ft. Now the market value ranges from \$1-5. For the manure system to be practical, there must be a manure system which allows the digester to be "fed" daily. (Merryman-East Central)

5521-A11, B1 TEAR DROP SLATS CHOP CON- FINEMENT COST, IMPROVE CATTLE COMFORT

Editor, Beef
P. D. Andre
Beef, V. 15, No. 6, p. 31-32, Feb., 1979. 2 fig.

Keywords: Slatted floors, Design, Confinement, Animal health

The latest innovation in slatted floor design is called the "Tear Drop" which is being built by Corral Industries of Phoenix, Arizona. According to Richard Bunker, president of Corral Industries, the design offers these main points of superiority over previous floors: (1) Tear Drops are cheaper to construct because no pits are needed for scrapers or manure storage. (2) Cattle are more comfortable since they don't have to straddle the hump found on most flush flume floors. Also, since the floors are nearly level, there is better footing for men and animals. (3) Cattle stay cleaner. (4) No mechanical equipment is needed except one pump to return flush water to the head of the slats from the anaerobic pond, cutting maintenance, labor and repair costs. (5) The slats can be poured rapidly with an automation technique on the ground surface with a minimum of surface preparation. (6) A slight crown at the center of the slats substantially improves the drainage of urine and any free water into the slat openings. (7) Rounded edges on the slat openings are more resistant to chipping, which has been a problem with some other designs. (8) Sore feet problems are minimized by the textured surface of the slats which permits a dry, non-messy buildup of a slight manure pack. (9) There is no ammonia problem because manure is flushed from the building before this can occur. (10) The Tear Drop design allows the slats to cover 100% of the building floor without the need for sloped aprons on the outside edge, as is required in most deep pit or scraper systems. Current designs are available for buildings ranging in capacity from 1,000 to 5,000 head with either a warm or cold climate building. (Stiles-East Central)

5522-B1, C2, D2, D3, E2, E3, F1, F2 ANIMAL WASTE MANAGE- MENT: STATE-OF-THE-ART

Task Committee on Agricultural Waste Management of the Committee on Solid Waste Management of the Environmental Engineering Division
Journal of the Environmental Engineering Division, V. 104, No. EE6, p. 1239-1262, Dec., 1978. 1 fig., 7 tab., 61 ref.

Keywords: Animal wastes, Management, Waste treatment, Legal aspects, Economics, Waste Composition, Land application

A state-of-the-art is given concerning animal waste management. Waste production and characteristics, regulatory considerations, treatment methods and engineering controls, animal waste utilization, and economic considerations are discussed. The two major waste loads to be handled are production unit manure or wastewater and rainfall runoff from feedlot areas. The two typical producer situations are when land is not limiting and maximum nutrient or fertilizer utilization can be exercised and land is limited and degradative pretreatment is required. The basic design principles and performance criteria required to allow routine design of runoff retention facilities and pretreatment unit processes for either waste conservation or degradation prior to terminal land applica-

tion are well documented. The versatility and capacity of land systems to stabilize and recycle waste constituents to valuable food and fiber must be fully utilized; and thus these materials should not be removed in pretreatment. The major role of pretreatment processes are for waste handling, storage and constituent conservation, or degradation, depending upon land availability. If land is so limiting that extensive engineering pretreatment is required, then livestock production at such a site may become uneconomical primarily because of exorbitant waste treatment costs. Land application of livestock waste offers the most cost effective management alternative for satisfying the zero-discharge goal. (Merryman-East Central)

5523-A12, B2, C2, D3, E3 THE PRACTICE OF METHANE PRODUCTION FROM ANIMAL WASTES

Ministry of Agriculture and Fisheries
A. J. Dakers
The Practice of Methane Production from Animal Wastes, Ministry of Agriculture & Fisheries, 1977, 47 p. 6 fig., 4 tab., 33 ref.

Keywords: Recycling, Animal wastes, Methane, Waste composition, Design, Safety

This New Zealand report was written to make available sufficient information to enable an assessment of the feasibility of producing biogas by the anaerobic digestion of animal wastes. Most of the information supplied is based on overseas research. For this reason, it should be kept in mind that New Zealand farming procedures and the waste characteristics are unique, and until research has been carried out in this country more reliable information will not be available. No attempt was made to make a general assessment of the cost benefit of such a system. The science of biogas production is discussed along with engineering aspects of the biogas plant. Plant operation is described. Uses and characteristics of biogas are presented. A step by step procedure for assessing the feasibility of methane production is outlined. (Merryman-East Central)

5524-A8, B2, C2, E2 EFFECT OF SHORT-CHAIN FAT- TY ACIDS EXTRACTED FROM BEEF CATTLE MANURE ON GERMINATION AND SEEDLING DEVELOPMENT

Agriculture Research Service, High Plains Grasslands Research Station, Cheyenne, Wyoming 82001
G. E. Schuman and T. M. McCalla
Applied and Environmental Microbiology, V. 31, No. 5, p. 655-660, May, 1976. 4 fig., 8 tab., 11 ref.

Keywords: Cattle wastes, Composting, Land application, Crop response, Salts, Waste composition

Composted and fresh beef cattle manure samples were extracted with distilled water, acetone, methanol, 2 N hydroxide, 2 N hydrochloric acid, and ether. Bioassay tech-

niques, using the extracts, showed that composted manure extracts had limited effect on seed germination and seedling development of wheat and sorghum. All the extracts of fresh manure, other than distilled water, retarded germination. Acetic, butyric, propionic, valeric, and isovaleric acids were found in ether extracts of fresh manure at average concentrations of 348, 876, 578, 34, and 19 $\mu\text{g/g}$, respectively, on a dry-weight basis. However, only trace amounts of these acids were present in composted manure. Propionic acid up to the 200- $\mu\text{g/ml}$ level stimulated seedling growth. Acetic and butyric below the 200 $\mu\text{g/ml}$ level had no detrimental or beneficial effects on seedling development. When acetic, butyric, and propionic acids were mixed in equal parts, germination and seedling growth were reduced at all levels (50-500 $\mu\text{g/ml}$). (Schuman-High Plains Grasslands Research Station)

5525-B3, E3

USE OF LITTER FOR BROILER HOUSE HEATING

Agricultural Engineering Department, University of Maine, Orono, Maine
N. Smith, J. G. Riley, C. W. Kittridge, and N. E. Putnam

Paper No. 78-4552, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 15 p. 9 fig., 3 ref.

Keywords: Poultry litter, Fuels, Design, Fireboxes

Development of prototype fireboxes intended to burn broiler litter is described. Details of a unit designed to burn pelleted litter and replace the oil burner on an existing boiler are provided. (Smith-University of Maine)

5526-B2, C2, D3, E3

A 1900 M³ DIGESTER FOR LAYING-HEN MANURE, IOWA

Manager, Sunny Time Energy
D. A. Rockey, W. Turnaciff, and R. J. Smith
Paper No. 78-4569, American Society of Agricultural Engineers, 1978 Winter Meeting, Chicago, Illinois, Dec. 18-20, 1978, 20 p. 5 fig., 6 tab., 9 ref.

Keywords: Digesters, Methane, Design, Economics, Ammonia, Poultry wastes, Slurries

A biogas digester was tested at Haying operation at West Union, Iowa. Financial support for the design and construction of the facility was provided by the Haying family, who are strong advocates of energy recovery from agricultural residues, and by a grant from the Iowa Energy Policy Council. After construction, support for the monitoring program of Biogas of Colorado was obtained from the United States Department of Agriculture Rural Development Service. Digester design and operation are described. Design weaknesses are observed. Conclusions drawn from this particular study were: (1) Insulation is required on the roof of the digester. (2) The mixing power provided does not seem adequate because material seems to be accumulating in the digester, judging by inspection of influent and effluent mass

flows. (3) A formed concrete tank can be rendered sufficiently gas tight for use as a digester. (4) Centrifugal pumps, even with solids-handling impellers, are not satisfactory for pumping 13% laying-hen manure. (5) Methane can be produced at ammonia levels of 10,000 mg/L but the gas quality is poor. (6) Volatile fatty acid levels were usually over 20,000 mg/L, suggesting a low rate of methanogenesis. (7) Although undiluted poultry manure can be digested, the relation among the variables digester volume, gas production, dilution, and storage volume should be examined to determine the combination giving the lowest cost per unit of gas produced. It was also found that while the cost of generation is too high to encourage methane generation economically, the performance achieved so far should be capable of improvement. Thus economic feasibility may still be achievable. (Merryman-East Central)

5527-B2, C1, C2, D3, E3

CHANGES IN PROPORTIONS OF ACETATE AND CARBON DIOXIDE USED AS METHANE PRECURSORS DURING THE ANAEROBIC DIGESTION OF BOVINE WASTE

Cawthron Institute, Nelson, New Zealand
D. O. Mountfort and R. A. Asher
Applied and Environmental Microbiology, V. 35, No. 4, p. 648-654, April, 1978, 3 fig., 5 tab., 19 ref.

Keywords: Recycling, Anaerobic digestion, Methane, Waste composition, Cattle wastes, Acetate, Carbon dioxide

In an anaerobic digester which was fed daily with bovine waste, during the early stages after feeding (4 to 7 h) acetate (via the methyl group) accounted for almost 90% of the methane produced. As time after feeding increased, acetate declined as a precursor so that in the 12- to 14-h and 21- to 23-h periods after feeding the methyl group accounted for 80 and 73% of the methane produced, respectively. Measurements of methane production from CO_2 reduction showed that in the 2- to 12-h period after feeding, CO_2 accounted for 14% of the methane produced, whereas in the 12- to 24-h period it accounted for 27.5%. These results show that the percentages of methane accounted for by acetate and CO_2 vary with time after feeding the digester. (Mountfort-Cawthron Institute)

5528-B2, B4, C3

ENUMERATION AND ISOLATION OF ANAEROBIC MICROBIOTA OF PIGGERS WASTES

Laboratory of Microbiology, Agricultural University, Wageningen, The Netherlands
S. F. Spoelstra
Applied and Environmental Microbiology, V. 35, No. 5, p. 841-848, May, 1978, 8 tab., 19 ref.

Keywords: Swine wastes, Microorganisms, Identification techniques, Anaerobic, Slurries

Media for enumeration of the microbiota of anaerobically stored piggery wastes were tested. Highest colony counts were obtained with 80 to 100% farm slurry supernatant included in the anaerobic roll tube media. Colony counts with these media numbered 2×10^6 to $12 \times 10^6/\text{g}$ (wet weight), which represents about 20% of the microscopic colony counts. Lower percentages of slurry supernatant in the media gave lower colony counts. Addition of glucose, cellobiose, and starch or of Tryptocase to media with 20% slurry supernatant did not increase colony counts. Higher values were obtained when hemicellulose preparations were added to these media. Incubation at 25°C gave the highest numbers. Incubation at 15 to 37°C gave counts of about 70 and 10% respectively, of those at 25°C. Of the colonies picked for isolation, about 20% were obtained in pure culture. The isolates apparently belonged to the genera *Peptococcus*, *Ruminococcus*, *Peptostreptococcus*, and *Bacteroides*. (Spoelstra-Agricultural University)

5529-A3, B1, C1, C2, C3, E2

QUALITY CHARACTERISTICS OF AGRICULTURAL AND WASTE DISPOSAL RUNOFF WATER

Department of Agricultural Engineering, University of Tennessee, Knoxville, Tennessee 37901
C. H. Shelton and G. M. Leseman
Journal of Soil and Water Conservation, V. 33, No. 3, p. 134-139, May-June, 1978, 9 tab., 9 ref.

Keywords: Agricultural runoff, Nonpoint sources, Land application, Livestock wastes, Agricultural wastes, Fertilizers, Nitrates, Phosphates, Salts, Fecal coliforms, Metals

We collected samples of runoff water from four Tennessee watersheds subjected to various cropping, tillage, fertilization, and/or waste disposal practices over a three-year period. Among the quality constituents we examined were nitrates, phosphates, chlorides, dissolved solids, sediment, suspended matter, turbidity, biochemical oxygen demand, dissolved oxygen, fecal coliform, and 13 selected metals. Concentrations of most of the constituents in runoff water were generally low. Highest concentrations were usually associated with high antecedent rainfall and the absence of vegetative cover. (Shelton-University of Tennessee)

5530-B1, C3

MEDIUM FOR THE ENUMERATION AND ISOLATION OF BACTERIA FROM A SWINE WASTE DIGESTER

Department of Agricultural Engineering, University of Missouri-Columbia, Columbia, Missouri
E. L. Iannotti, J. R. Fischer, and D. M. Sievers
Unpublished paper, American Society for Microbiology, Annual Meeting, New Orleans, Louisiana, May 6-13, 1977, 39 p. 2 fig., 10 tab., 46 ref.

Keywords: Bacteria, Swine wastes, Digesters

A habitat-simulating medium was developed for the enumeration and isolation of bacteria from a swine waste digester. A roll tube medium with growth factors for strict anaerobes from previously studied anaerobic ecosystems was used to evaluate deletion, addition, or level of digester fluid, digester fluid treated with acid or base, rumen fluid, fecal extract, anaerobic pit extract, tissue extract, carbohydrates, peptones, short-chain fatty acids, minerals, vitamins, nitrogen, and phosphorus sources, reducing and solidifying agents, buffers, and gases. A medium (174) containing digester fluid, peptones, minerals, cysteine, sodium carbonate and agar permitted recovery of 80% of the microscopic count and improved yields 2.5 to 20 times over media previously used for digesters or developed for other anaerobic ecosystems. Increasing agar concentrations decreased the recovery. Blending increased counts 1.7 times. Colony counts continued to increase up to 4 weeks incubation. Medium 174 permits the enumeration of total, methanogenic and, with deletion of reducing agent, aerotolerant bacteria. The results suggest that the predominant bacteria grow slowly and have requirements different than those from other ecosystems. (Iannotti-University of Missouri)

5531-B2, B5, C2, E2 EMPTY LAGOONS EARLY TO REDUCE ODORS, SAVE NUTRI- ENTS

Anonymous
Wallace Farmer, V. 104, No. 8, p. 89,
March 24, 1979.

Keywords: Lagoons, Land application, Odor control, Nitrogen, Crop response

Stewart Melvin, Iowa State University extension agricultural engineer, recommends pumping down livestock lagoons in the spring in order to salvage more nitrogen and to reduce the lagoon's potential for giving off odors. The lagoon should be lowered to the minimum design volume. Some dilution water should be added back to the lagoon to prevent a salt buildup which can prevent the bacteria from working. Work is being done at Iowa State University to determine if lagoon waste can be irrigated on standing corn or sorghum without being detrimental to the plants. Melvin is not yet ready to recommend this practice because the lagoon could have a high ammonia level which would harm the plants (Merryman-East Central)

5532-B5, E3 CONDITIONING DAIRY COWS TO EAT TAINTED GRASS

Great House Experimental Husbandry Farm
P. Smith
Experimental Husbandry, V. 23, p. 37-42,
1973. 8 tab., 5 ref.

Keywords: Cattle, Refeeding, Cattle wastes, Pastures

In an indoor trial, cows were conditioned to consume fodder sprayed with a dilute slurry of

cattle wastes. The conditioned cattle, when offered the fouled herbage, rejected less than the control cattle. When the cattle were turned out to fouled grass, the conditioned cattle grazed more readily. When attempts were made to condition cattle to fouled herbage immediately after turnout to grass, difficulties were encountered. Estimates of herbage intakes from pre- and post-grazing cuts were erratic and rendered the results inconclusive. Although cows can be turned on to fouled pasture in spring and made to eat tainted grass, this would not be commercially acceptable. It would certainly be uneconomic to sacrifice the spring rise in milk yield to save herbage later on when many cows are nearing the end of their lactation anyway. A further practical difficulty would be ensuring that during the spring conditioning period, rapid growth of herbage did not get ahead of the cows enabling them to select untainted herbage. (Merryman-East Central)

5533-B1, C2, D1, D2, D3, E3 ALGAE OFFERS EFFICIENT WAY TO RECYCLE SWINE WASTES

C. Glenn
Sunshine State Agricultural Research Report,
V. 23, No. 1, p. 23-24, Winter, 1979. 3 fig.

Keywords: Swine wastes, Anaerobic, Lagoon, Algae, Refeeding, Protein, Flocculation

Scientists at the University of Florida have been conducting experiments in which swine wastes are flushed from pig pens into an anaerobic lagoon. From there the wastewater is fed gradually into a four-channel system to maintain equilibrium with the water being fed into the lagoon. Algae is grown in these four channels. Pollutants and odor are removed rapidly by the algae. The last channel in the system is harvested each day by flocculation. The algae is dried, ground, and incorporated into feed as a protein supplement. This process will yield 10 tons of algae per acre. A filamentous alga that can be harvested from the channels without flocculation is being investigated. Performance of swine fed an algae supplemented diet is also being tested. (Merryman-East Central)

5534-B2, C2, D3, E3 MSU PROCESS TURNS WASTE FILTRATE INTO SUPPLEMENT

Anonymous
Feedstuffs, V. 50, No. 52, p. 12, Dec. 18,
1978.

Keywords: Fermentation, Feedlot wastes, Carbohydrates, Refeeding, Temperature

A batch fermentation process for converting feedlot waste filtrate plus a waste carbohydrate source into a ruminant feed supplement has been developed at Michigan State University. The study examined the effect of carbohydrate waste source and concentration, pH, temperature and ration composition on the fermentation of the feedlot waste filtrate (FLWF). Feedlot waste containing 16.4% total solids was diluted 1:1 with water, me-

chanically agitated until a homogenous slurry was obtained and hand pressed through a sieve to remove large particulate materials. The filtrate gathered contained 16.6% total solids originally present in the feedlot waste. This FLWF was supplemented with waste carbohydrate sources such as cheese whey powder, corn starch, molasses, and potato starch at controlled pH and temperature for 24 hours. All fermentations were carried out in a 28-liter laboratory fermentor and agitated at 450 rpm. Indigenous microbial flora served as the inoculum. The study revealed that the highest rate of fermentation, as measured by the rate of TN increase, was obtained for FLWF supplemented with cheese whey powder at 5 g/100 ml when fermentation was maintained at pH 7.0 or 7.5; the fermentation was essentially complete within eight hours at this pH. The crude protein content of the resulting product was 78% (dry basis). The optimum rate of fermentation was obtained at 43°C. The study indicated that it would be advantageous for the feedlot operator to conduct fermentations without temperature control, thereby saving energy and production cost, as long as the ambient temperature is not below 20°C. Carbohydrate sources all fermented efficiently and the crude protein content in the products were comparable. It was found that fermenting FLWF supplemented with 7-10% carbohydrate will yield a product with higher levels of crude protein and organic acids. Further studies are in progress to scale up this fermentation process to pilot plant scale. Feeding trials will be performed as soon as efficient product is obtained. (Merryman-East Central)

5535-A9, A11, C2, E3 FEED ADDITIVE RESIDUES IN ANIMAL MANURE PROCESSED FOR FEED

Agricultural Environmental Quality Institute,
Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland
C. C. Calvert
Feedstuffs, p. 32-33, April 23, 1973. 13 tab.,
18 ref.

Keywords: Feed additives, Refeeding, Animal wastes, Poultry wastes-dried, Arsenic, Amprolium, Drugs

A problem associated with the use of animal manure for feed is their possible contamination by residues of numerous feed additives currently used in animal production. Principal sources of contamination are: (1) feed spillage from feeders and feed troughs and (2) passage of additives through the animal digestive system with little change in the chemical and physical characteristics of the compound. This report describes the general categories of feed additives, and indicates those additives which have more potential for problems, and reviews the work that has been done to determine whether specific additives are contributing residues to manure and the distribution and effect of these residues when fed to other animal species. Arsenic content of dried poultry wastes used as a feed supplement has been of particular concern. Studies were conducted in which such poultry wastes were fed to sheep. It was found that an average of 87% of ingested arsenic was excreted by the sheep. In other studies, arsenic from arsenic acid fed at levels up to 273 mg/kg of diet was detected in tissues of sheep and the level in tissue appeared to be proportional to the level fed. A six-day withdrawal period seemed to be

sufficient to decrease tissue arsenic in these studies. Milk and blood arsenic were increased when arsenic was fed to lactating cows from either arsenic acid or 3-nitro-4-hydroxyphenylarsonic acid, but after a seven-day withdrawal period, arsenic levels were reduced to levels found before arsenic feeding. Similar experiments with other important feed additives need to be conducted before final judgements can be reached on the safety of animal manure as a feed ingredient. (Merryman-East Central)

5536-A8, B1, B5, C2, E2 IT'S IMPORTANT TO KNOW HOW MUCH MANURE TO APPLY

E. A. Liegel
Hoard's Dairyman, V. 124, No. 5, p. 322, 370,
March 10, 1979. 2 fig., 6 tab.

Keywords: Animal wastes, Land application, Crop response, Soil contamination, Nitrates, Phosphorus, Salts, Potassium, Ammonia

Many dairymen spread manure on fields that are planted continuously to corn. Both soil and plant problems can result when too much manure is applied. Major soil problems include high levels of nitrate nitrogen and excessive soil test levels of available phosphorus. Michigan studies have shown that annual manure applications of 20 to 60 tons of gutter manure per acre can raise soil-test phosphorus levels to 120 to 180 pounds per acre. High soil-test phosphorus levels should be avoided on soils subject to erosion. Phosphorus is carried to waterways by soil erosion since it is attached to soil particles. The phosphorus will stimulate weed growth in lakes and ponds. Three plant problems which can develop in cornfields which have received excessive nitrogen from manure in a given year are ammonia toxicity on germinating seedlings, high nitrate nitrogen levels in corn silage and excessive amounts of salts. Current University of Wisconsin recommendations indicate that forages containing less than 1,000 ppm nitrate nitrogen can be fed to dairy cows safely. Special precautions must be followed when feeding forages containing more than 1,000 ppm of nitrate nitrogen. Nitrate levels can be reduced by ensiling. Another plant problem is buildup of soil salt level and subsequent plant intake after heavy annual doses of manure. In a Kansas study, researchers noted corn plants growing on areas receiving 240 or 300 tons of manure per acre showed visual signs of salt damage on leaf tips. Ammonia, nitrate nitrogen, and soil salt problems are generally temporary. Although high levels may accumulate from a heavy dose of manure during one year, they usually are dissipated within one to two years. High soil-test levels of phosphorus and potassium are long-term soil problems. These levels can be lowered by planting such fields to a high-demanding crop like alfalfa. A period of four to ten years may be required to lower such high soil-test levels by cropping. Spreading of solid manure on alfalfa should be avoided if possible. Soil and corn plant problems can be avoided by applying only enough manure to meet crop needs. University of Wisconsin studies have shown corn to remove about 40 percent of the nitrogen, 15 percent of the phosphorus and 50 percent of the potassium in manure the year of application. Generally, about 40 percent of the nitrogen in manure will be made available the first year. Manure should be analyzed before applying it to the land. (Merryman-East Central)

5537-A11, B3, C2, E3 THE ACCUMULATION OF COPPER IN THE LIVER OF LAMBS ON DIETS CONTAINING DRIED POULTRY WASTE

Moreduin Research Institute, Edinburgh EH17 7JH, Scotland
N. F. Suttle, C. S. Munro and A. C. Field
Animal Production, V. 26, p. 39-45, Feb., 1978. 1 fig., 4 tab., 18 ref.

Keywords: Poultry wastes-dried, Refeeding, Sheep, Toxicity, Copper

The accumulation of copper (Cu) in the liver of lambs on diets containing dried poultry waste is studied. Eight groups of newly weaned lambs were given diets containing .5, 30, 45, or 60% dried poultry waste (DPW) from battery or broiler units in a 4 x 2 factorial experiment lasting 18 weeks. The study concludes that at lower Cu levels, the inclusion of 15% broiler waste in cereal based diets of relatively high Cu availability may be safe for up to a year, provided that initial liver Cu concentrations are low. The results of an earlier experiment (1972) suggest that higher inclusion rates can be tolerated by pregnant ewes given roughage based diets. The use of battery waste may be restricted by the presence of toxic factors other than Cu. (Solid Waste Information Retrieval System)

5538-A10, B1, C3 LARVAL DEVELOPMENT OF MUSCA SORBENS IN ANIMAL DUNG IN HAWAII

Department of Entomology, University of Hawaii, Honolulu, Hawaii 96822
R.F.L. Mau
Annals of the Entomological Society of America, V. 71, No. 4, p. 635-638, 1978.

Keywords: Flies, Animal wastes, Poultry wastes, Cattle wastes

The breeding potential of *Musca sorbens* Wiedemann was determined in cat, dog, cattle and chicken wastes. Significantly more larvae completed development in dog and cat than in cattle wastes. Differences in flies emerging from dog and cat wastes were not significant. Chicken wastes were not suitable for *M. sorbens* larval development. No larvae developed into pupae in chicken wastes. (Merryman-East Central)

5539-B2, B4, B5, C2, E2, F1 EARTHEN STORAGE BASIN STOPS WASTE

Editor, Dairy Herd Management
G. Ashfield
Dairy Herd Management, V. 15, No. 5, p. 18-20, 22, 24, 26, 28, April, 1978. 9 fig.

Keywords: Waste storage, Dairy wastes, Economics, Liquid wastes, Land application, Design

An earthen basin for the storage of waste from dairy animals is described. The storage capacity of the basin is estimated at 2.1

million gallons and is capable of storing waste from approximately 150 mature dairy animals for up to 18 months. Costs for constructing the basin on a private dairy farm totaled about \$30,000. Planning and construction aspects of the basin's development are detailed. Nutrient retention and eventual utilization on cropland is an important feature of the liquid waste storage system. Liquid manure is applied at a rate of 36 t per acre, a figure recommended by the University of Wisconsin. The manure is applied in spring and fall using management techniques that allow the most value in terms of crop nutrients and that minimize required commercial fertilizer or straight nitrogen. It is felt that the benefits of the basin substantially negate the investment made to handle liquid waste. (Solid Waste Information Retrieval System)

5540-B2, B3, B4, E2 SCRAPE/SLOPE SYSTEM SEPARATES SOLID & LIQUID WASTE

Editor, Dairy Herd Management
G. Ashfield
Dairy Herd Management, V. 15, No. 4, p. 30-35, March, 1978. 3 fig.

Keywords: Dairy wastes, Separation techniques, Confinement pens, Waste storage, Land application, Design

A scrape/slope system of separating solid and liquid waste on a dairy farm is described. The dairyman uses semiconfinement freestall housing for the cattle, using a skid/steer loader to push wastes onto a sloping concrete floor where separation occurs. Solids are disposed of with conventional spreading equipment, while liquids (carried by gravity to a settling basin) are pumped to an adjacent holding pond. The main problem occurs in cold weather when ice and cold prevent full operation of the system. The waste and water produced in the milking parlor is also linked into the system's waste handling design. Operational efficiency has been high, while costs of maintaining the system have been low. The system is recommended for other dairy operations. (Solid Waste Information Retrieval System)

5541-B3, C1, C2, C3 WATER, MINERAL AND ENERGY FLUCTUATIONS IN DECOMPOSING CATTLE DUNG PATS

St. Mary's College of the Sacred Heart, Newcastle upon Tyne, Newcastle, England
V.H.S. Underhay and C.H. Dickinson
Journal of the British Grassland Society, V. 33, p. 189-198, 1978. 2 fig., 2 tab., 11 ref.

Keywords: Cattle wastes, Decomposition, Moisture content, Calcium, Iron, Magnesium, Potassium, Nitrogen, Ash, Microorganisms

Naturally deposited and artificially placed dung pats were sampled during decomposition to determine changes in Ca, Iron (Fe), Mg and K concentrations, pH, water, ash and total N concentrations and calorific value. The decomposition of dung pats was accompanied by drying of the dung, the rate of which was closely related to the weather. Once it had

dried, the dung was not readily rewetted but the rainfall had marked effects on the loss of soluble cations. Soluble mineral ions were only leached from pats by prolonged rainfall. Magnesium was particularly resistant to leaching. Loss of organic matter over a 62-day period of decomposition in May and June amounted to 15% of the air-dry dung. The calorific value of the dung decreased 18% during the same period. The loss of organic matter led to increases in levels of Ca, Mg, Fe, and N. Such changes in dung will affect the coprophilous microorganisms. The colloidal nature of dung probably results in high matrix and osmotic forces with which coprophilous organisms must compete for water. The growth of many organisms may, therefore, cease at relatively high water contents. (Merryman-East Central)

5542-A8, B3, C2, E2 INFLUENCE OF ORGANIC FERTILIZERS ON THE SOLUBILITY AND AVAILABILITY TO PLANTS OF HEAVY METALS IN SOILS

Department of Soil Sciences, Swedish University of Agricultural Sciences, S-750 07 Uppsala, Sweden
A. Andersson
Grundforbattring, V. 27, No. 4, p. 159-164, 1975/76. 5 tab., 4 ref.

Keywords: Land application, Animal wastes, Sewage, Compost, Heavy metals, Crop response

Manure, sewage sludge, and compost from solid wastes and sewage sludge were utilized in laboratory and field experiments to test the influence of the organic matter in organic fertilizers on the solubility and availability to plants of heavy metals in soil and fertilizer. It was found that organic fertilizers added to soils may reduce the solubility and uptake in plants of heavy metals, despite high contents of these elements. The reason is that the uptake is in proportion to the soluble and mobile fractions rather than to the total content, and the reducing influence of the organic matter on the solubility and mobility is stronger than the increasing influence from the higher total contents. The effect seems to be particularly strong in the case of Pb, but can also be found for other heavy metals, provided the content of the element in question is not too high in the organic fertilizer. Whether the solubility and availability to plants are reduced or not is dependent upon competition between the reducing effect on the solubility from the organic matter of the fertilizer and the opposite effect from the quantity of heavy metals added together with the organic matter. Other important factors are type of organic matter and physico-chemical properties of the soil. (Merryman-East Central)

5543-B2, C2, D3, E3 ANIMAL AND POULTRY WASTES AS AN ENERGY SOURCE

Anonymous
Canadian Poultry Review, V. 98, No. 4, p. 40, 42, April, 1974.

Keywords: Recycling, Anaerobic digestion,

Pyrolysis, Hydrogasification, Carbon, Nitrogen, Methane, Biogas, Poultry wastes, Animal wastes

Four basic ways of converting animal wastes into useable forms of energy are: (1) Cellulose and lignins, which compose much of the organic matter in animal wastes, are converted into low-sulfur oils. (2) Hydrogasification converts animal wastes into methane and ethane through a reaction of the dried manure with hydrogen. (3) Pyrolysis of wastes requires wastes to be heated in a sealed vessel to between 200° and 900° C and yields a combination of oil, gas and solid residue. (4) The most practical method of converting animal wastes into energy is by anaerobic digestion. One of the prerequisites for successful operation of an anaerobic digester is a carbon nitrogen ratio of 30 to 1, the ratio required by the bacteria which do the work. The biogas produced contains methane, carbon dioxide, hydrogen sulfide, and other gases. It has a heat value of between 550 to 770 BTU per cubic foot. The other by-product is a sludge which has value as a fertilizer and can be applied more heavily than chicken manure. Biogas may be utilized as a substitute for natural gas or other commonly used gases in their many applications. Anaerobic digestion systems have been used in hog growing operations quite successfully. Broiler operations seem to be ideally suited for the method. Litter from broiler houses possesses the proper carbon nitrogen ratio. Clear manure from a caged layer operation has a carbon nitrogen ratio of 15 to 1 which would have to be corrected to 30 to 1 by the addition of a carbon-rich material, such as sawdust. (Merryman-East Central)

5544-B2, C2, D3, E2, E3 CHANGES IN SWINE MANURE DURING ANAEROBIC DIGESTION

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E.L. Iannotti, J.H. Porter, J.R. Fischer and D.M. Sievers
Canadian Poultry Review, V. 98, No. 4, p. 40, 42, April, 1974. 8 tab., 30 ref.

Keywords: Swine wastes, Anaerobic digestion, Recycling, Methane, Rerefeding, Land application, Carbohydrates, Lipids, Proteins, Short-chain acids, Waste composition

This paper reports on the chemical changes occurring in the manure during anaerobic digestion and through these changes assesses the metabolic activity of the total microbial population and further uses of the end products. A swine waste digester was operated at a detention time of 15 days, 35° C and a loading rate of 4 g volatile solids/liter/day. Complex carbohydrates were the largest class of compounds destroyed during the conversion of the swine waste to biogas. Decomposition of lipids, proteins, and short-chain acids also contributed to methane production. Incorporation of anaerobic digestion into swine waste handling would reduce the VS 60% and the COD 58%, greatly decreasing the amount of waste to be discarded and at the same time yielding fuel gas. After anaerobic digestion, the remaining wastes may be further broken down in a lagoon or they may be rerefed or applied to land. Before the rerefeding value of the effluent is judged, the quality of the effluent must be experimentally determined; the economics of the gain in nitrogen, minerals, and vitamins

determined; and the engineering problems in water removal worked out. If applied to the land, the effluent (which is a rich source of N, P and K) should be injected into the soil or up to 90% of the ammonia may volatilize within five days if the effluent is applied to the surface. (Merryman-East Central)

5545-B2, C2, D3, E3, F2 DIGESTION OF POULTRY MANURE FOR METHANE RECOVERY

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T. Aglira, K. Artes, D. Cruzan, and T. Chaykun
Project Design Report, Department of Mechanical Engineering, Drexel University, May, 1971, 45 p. 2 fig., 4 tab., 26 ref.

Keywords: Recycling, Methane, Digesters, Design, Poultry wastes, Economics

The goal of this project was to design an efficient and profitable system for dealing with the large daily amounts of waste from highly populated poultry farms. An experimental digester was built. Several experiments were run to obtain optimum operation for methane production. Because of the similarity between chicken manure and sewage sludge, data on sewage sludge (for which there is more information) is presented. The basic steps in the digestion procedure of raw sludge are: (1) raw sludge put in digestion tank, (2) heat addition, (3) anaerobic bacteria - mixing, (4) liquification - Saprophytic bacteria, (5) gasification - methane bacteria, (6) settling and dewatering, and (7) disposal. Digester design and cost data are presented. Research indicates that a considerable economic savings could be realized if the excess gas were used to power a generator needed to fulfill the power requirements of the farm. Storage tanks, a compressor, and a generator would be needed to accomplish this. Since the trend today is to control wastes from confined animals by law, the digestion system discussed seems to be the most economical answer to the waste problem. Any alternative solution to the problem does not provide the overall advantages inherent in this system, since other methods of treatment are costly and do not provide any economic returns. (Merryman-East Central)

5546-A5, A8, B1, C2 FEEDLOT POLLUTION IN CENTRAL ALBERTA

J.A. Robertson and J.B. McQuilty
Agriculture and Forestry Bulletin, V. 1, No. 1, p. 28-29, 1978. 2 fig., 1 tab., 8 ref.

Keywords: Feedlots, Canada, Soil contamination, Groundwater pollution, Sampling, Nitrate, Chloride, Ammonium

At each of six feedlots in central Alberta soil cores were collected to depths of about three meters at several locations within and outside the lot. The cores were divided into 0.3 m sections, with each section being analyzed for water soluble nitrate, chloride, and for extractable ammonium (NH₄). Data were

summarized for six cores from within the feedlots (one from each lot) and six cores outside or on the border of feedlots (one from each lot). There was little enrichment of ammonium in the soil under the feedlots. There were rather marked accumulations of both nitrate and chloride ions down to depths of one or two meters in some cores in most feedlots. The extent of movement was usually greatest in portions of three feedlots which had been parts of barnyards for many years and in the soil under small depressions that were present in some feedlots. There was some enrichment of nitrate at three-meter depths, the maximum depth sampled. Water samples taken from wells varying from thirty to ninety meters in depth in four of the lots showed no nitrate enrichment; chloride was found in one of them. Both from the viewpoint of loss of valuable plant nutrients and of potential groundwater pollution, it seems desirable to take steps to minimize the movement of water into the ground below feedlots. Recommended practices are: (1) Remove the manure as soon as possible each spring before summer rains can wash through it and before the rates of mineralization, nitrification, and volatilization are speeded up by warm summer temperatures. (2) Level the surface of the feedlot to prevent concentrating more than normal rainfall in small areas. (3) Use liberal amounts of straw to absorb as much moisture as possible and to prevent release of mineral nitrogen (ammonium and nitrate). (4) Maintain a high stocking density so the manure pack is kept compact and moist. (5) If the feedlot is not used during the summer, seed a cereal crop on it. The cereal crops should not be used as feed because of the probability of a high nitrate content. (Merryman-East Central)

5547-A11, C2, E3 POULTRY WASTES - NITROGEN FOR COWS

Anonymous
Agricultural Research, V. 26, No. 10, p. 15,
April, 1978.

Keywords: Poultry wastes-dehydrated, Re-feeding, Dairy cattle, Milk production, Nitrogen

Dehydrated poultry manure is discussed as a potential source of dietary nitrogen for lactating dairy cattle. Research has shown that cows fed diets supplemented with dehydrated poultry excreta consume about the same amount of feed but give slightly more milk than cows fed diets supplemented with urea. It is pointed out, however, that dried poultry manure is not registered for commercial use by the Food and Drug Administration. The research was conducted at the Beltsville Agricultural Research Center in Maryland. Four diets were fed to groups of six Holstein cows. The diets consisted of a corn/soybean meal concentrate supplemented with one of the following: 2% urea, 17.2% dehydrated poultry excreta, 26% dehydrated poultry excreta, or additional soybean meal. Costs of the concentrates per metric ton were \$133 for the urea supplemented diet; \$125 and \$119, respectively, for the 17.2% and 26% dehydrated poultry excreta diets; and \$137 for the soybean meal diet. (Solid Waste Information Retrieval System)

5548-A5, A11, A12, B1, C2, D3, E3 DAIRY FARM MANURE STUD-

IED FOR TOXICITY

Anonymous
Journal of Environmental Health, V. 41, No. 4, p. 217, Jan.-Feb., 1979.

Keywords: Public health, Animal health, Trace minerals, Refeeding, Dairy wastes, Soil amendments, Fuels, Groundwater pollution

A pilot plant utilizing a system developed by Ceres Ecology Project of Colorado has been constructed in Southern California. The system converts dairy manure into: (1) a silage suitable for cattle feeding or as processing plant boiler fuel, (2) a protein rich feed ingredient for several different animals, fish and fowl, and (3) a soil amendment. The primary purpose of investigating the system's possible use in Southern California is to protect the underground water in the Chino Valley through a suitable and economically productive method of disposing of the manure produced by 163,500 dairy cattle in the area. Work is being done to determine the amount of toxic substances in dairy farm manure in order to evaluate the feasibility of recycling such waste to animal feed. Emphasis is on 10 trace metals - lead, arsenic, mercury, zinc, manganese, copper, iron, chromium, nickel and cadmium and its impact on animal and human health. (Merryman-East Central)

5549-B2, C2, D3, E3 MULTISTAGE CONTINUOUS FERMENTATION OF POULTRY MANURE TO A HIGH PROTEIN FEEDSTUFF

School of Chemical Engineering, Cornell
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D.W. Mitchell and M.L. Shuler
AIChE Symposium Series, V. 74, No. 172, p.
182-188, 1978. 2 fig., 4 tab., 14 ref.

Keywords: Poultry wastes, Fermentation, Refeeding, Nitrogen, Proteins

Large scale laying operations produce large quantities of poultry manure that are hazardous to the environment and an economic liability for operators. Such wastes can release significant quantities of fixed nitrogen as ammonia which can have adverse effects on health as well as causing algal blooms, odor, or other environmental damage. Fixed nitrogen is the key component for the production of scarce protein. A process is described for the microbial conversion of poultry waste into a high protein feedstuff using a multistage continuous fermentation scheme. The first stage utilizes available carbohydrates and converts uric acid into ammonia (and cells). In a second stage, external carbon is added to complete the conversion of ammonia to bacterial protein. In this paper the effects of temperature, pH, dilution rate, and dissolved oxygen on the conversion of fixed nitrogen into bacterial cells are examined. The natural flora is employed in this work; the growth characteristics of the natural flora must be known before the utilization of pure strains can be profitably examined. (Mitchell-Cornell University)

5550-A11, B1, E3 LAYER MANURE MAKES US- ABLE FEEDSTUFF, AFFECTS CARCASS

J. Trevis
Feedstuffs, V. 51, No. 9, p. 12, Feb. 26, 1979.
1 tab.

Keywords: Refeeding, Poultry wastes, Swine, Performance

In a study, 21 crossbred, weanling pigs were divided into pens with aluminum-slotted flooring. Fresh manure was added to corn-soybean meal premix as a source of protein, calcium, phosphorus and other nutrients at 0, 5 and 10% levels. All diets had protein adjusted to 16% in the growing phase and 14% in the finishing phase. Diets were changed to the finishing diet as pigs reached 55 kg body weight. The diet with 10% poultry manure significantly decreased average daily gain (1.30 lb. versus 1.65 lb. for the diet with no manure). On a dry basis the conversion to body weight was similar to feed without manure (2.87 and 2.85 for control and 10% manure diets, respectively). A metabolism study was also conducted to determine metabolizable energy, digestibility of protein, crude fiber, nitrogen free extract, fat and nitrogen retention. Metabolizable energy declined as layer manure was added, as did digestibility of crude fiber and fat. Digestibility of crude protein was not affected by adding layer manure to diets. Decreased nitrogen retention of pigs fed 10% layer manure indicated lack of urea utilization by the pigs. (Merryman-East Central)

5551-B2, C2, E3 PERFORMANCE OF ANAEROBIC LAGOON SYSTEMS FOR DIS- POSAL OF WASTE FROM CAGE LAYER HOUSES

Agricultural and Biological Engineering
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sippi 39762

J.B. Allen, R.L. Haynes, and J.E. Hill
Research Report, Mississippi Agricultural and
Forestry Experiment Station, Mississippi
State University, V. 1, No. 13, May, 1975, 4 p.
6 fig., 1 tab.

Keywords: Lagoons, Anaerobic, Poultry
wastes, Waste disposal, Flushing, Biochemi-
cal oxygen demand, pH, Fertilizers

Cage layer production of edible eggs has become concentrated in high-density confined operations that produce large quantities of waste. Many poultry growers utilize anaerobic lagoons as a low-cost, low-labor waste management system. In an attempt to reduce problems with waste handling and with lagoon overflows, some growers have developed a system of recycling the lagoon effluent to flush out the cage layer houses. This system requires less labor for cleaning the house and produces less lagoon effluent because of the high evaporation from the collection pits. A study was designed to: (1) evaluate the efficiency of anaerobic lagoons in reducing biochemical oxygen demand (BOD) from cage layer wastes, (2) evaluate the operation of systems for flushing cage layer houses with recycled lagoon effluent, and (3) determine the fertilizer value of chicken waste, slurry and lagoon contents. Lagoons at two modern cage layer production units near Mendenhall, Mississippi were selected for study. Average BOD from Farm A's raw waste and effluent was 9932 mg/liter and 359/liter, respectively - a removal efficiency of 96%. This was still far too high for release to streams. pH levels

of the two lagoons were between 7 and 8, indicating very favorable operating conditions. The slope of 3.5 inches/100 ft for the pits at Farm "A" appeared to be satisfactory. The slope of 9"/100 ft in the houses at Farm "B" required 2" x 10" baffle boards in the pit at about 50 ft intervals. Removal of the baffle boards required considerable labor. Only the raw waste and the slurry had a significant value as fertilizer. About 50% of the nitrogen in cage layer waste is typically in the form of ammonia which is lost unless the waste is incorporated into the soil immediately after spreading. (Merryman-East Central)

5552-B2, B4, C2 NUTRIENTS OF MANURE IN BASINS DEPEND ON AGITATION

Anonymous
Hoard's Dairyman, V. 124, No. 8, p. 485-486,
March 25, 1979.

Keywords: Waste storage, Dairy wastes,
Liquid wastes, Phosphorus, Nitrogen, Potas-
sium

Samples were taken from every 25th load as manure was being hauled from Connecticut dairy farms during the spring and summer. The samples were frozen until analyzed for dry matter, Kjeldahl nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O). Fresh samples were also included in the analysis. Three farms were studied closely. Study results revealed that: (1) Most liquid manure pits are not mixed thoroughly while being pumped. (2) A higher level of nutrients results from a covered underground storage. However, the additional cost of this kind of storage has to be weighed against the smaller volume of manure to haul on one hand, and the higher nutrient content on the other. (3) Nitrogen content increases gradually with higher dry matter contents. (4) Phosphate levels appear to be related directly to dry matter content. Highly soluble potash is not related closely to dry matter. For large open basins, nutrient levels did not tend to stabilize until basins were one-third to one-half empty. Contents then were about 20 to 24 pounds of N, 10 to 15 pounds P_2O_5 and 17 to 20 pounds K_2O per 1,000 gallons. (Merryman-East Central)

5553-A6, B2, D2, F1 EVALUATING COMMERCIAL PRODUCTS FOR ODOR CON- TROL AND LIQUIFICATION OF SWINE WASTES

Agricultural Engineering Department, Uni-
versity of Illinois, Urbana-Champaign, Illinois
D.J. Warburton, A.J. Muehling, D.L. Day,
A.H. Jensen, and S.E. Curtis
Livestock Waste Management Research Pro-
jects, University of Illinois, Oct., 1978, p. 2-6.

Keywords: Odor control, Swine wastes,
Chemical treatment, Liquification, Masking
agents, Economics

A University of Illinois project was conducted to evaluate the effectiveness of odor control products for controlling odors and liquifying solids in liquid manure pits in confinement swine finishing buildings located in the Midwest climate. Controlled experiments

were run testing 22 commercial products using a model of a manure pit so that the only variable was the commercial product added. The commercial products tested were: Sludge Away, Tec II, Symbax, Air Tite 771, E.P. Liquid Waste Control, Swine Aid, Biozyme-Lo, Subdu, Calrox, Micro Aid, Puritan Manure Treatment, Sanzyme, Enviro-Bac MD, Non-Scents, The Nose Knows (TNK), Inter-Loc, Bio-Clean, Stable and Barn Odor Control (SBOC), MasterZyme DL, Bacterial Waste Disposer (BWD), Fads, and Envald. In addition to these, other treatments were: waste oil, activated charcoal, wintergreen oil, chlorine, mechanical aeration and an experimental product formulated in the University of Illinois laboratories. Evaluation was conducted in accordance with basic principles of standard methods for odor evaluation. Odor panel evaluations were made on samples of treated manure, control samples, and samples of plain water. The overall performance of the commercial odor-control compounds was disappointing. The partial success of Tec II in improving odor acceptability was offset by its poorer performance in the solids analysis. Furthermore, its primary base compound is toxic — a recognized insecticide (with an LD_{50} of 800 mg/kg). It's as toxic as such herbicides as 2,4-D. It should be handled with care. It was felt that the masking agents were not effective because they were broken down by the bacteria. Although the University of Illinois experimental product was effective — and may be at still lower dosages — the cost at \$8.00/hog/year suggests that while chemical treatment for odor control is possible, it may not be the most economic alternative. Aeration for odor control still may be the most effective treatment, especially if recycle cleaning or refeeding are combined into the system. (Merryman-East Central)

5554-B2, C1, C2, C3, D3 VEGETATIVE FILTERS FOR CONTROLLING FEEDLOT RUN- OFF

Agricultural Engineering Department, Uni-
versity of Illinois, Urbana-Champaign, Illinois
D.H. Vanderholm, E.C. Dickey, S.L. Spahr,
and J.A. Jacobs
Livestock Waste Management Research Pro-
jects, University of Illinois, Oct., 1978, p. 6-7.

Keywords: Feedlot runoff, Vegetative filters,
Biological treatment, Water pollution

The vegetative filter system for treatment of open feedlot runoff was studied at four locations over a period of two years. The system was found to be an effective means of removing nutrients, solids, and oxygen-demanding materials from feedlot runoff prior to discharge. Bacteria levels in the runoff were not greatly reduced. Effluent discharged from the filters during large runoff events did not meet Illinois standards for stream quality. However, the discharge rates are usually relatively low and occur during periods of high stream-flow and, therefore, high dilution rates — resulting in negligible effects on stream quality, especially as compared to the uncontrolled discharges from open feedlots. Vegetative filters can provide a satisfactory, low-cost means of controlling feedlot runoff for many small and medium-size livestock feedlots, but such filters are not adaptable to every situation and some management is required for satisfactory performance. Chan-nelized flow systems appear to be less

effective than overland flow systems, requiring much greater flow lengths for a similar degree of treatment. (Merryman-East Central)

5555-B2, D3, F1 ELECTROCHEMICAL CON- VERSION OF ANIMAL WASTES INTO PROTEIN AND HYDROGEN

Department of Agricultural Engineering,
University of Illinois, Urbana-Champaign,
Illinois
D.L. Zierath, D.L. Day, M.P. Steinberg and
R.R. Kravets
Livestock Waste Management Projects,
University of Illinois, Oct., 1978, p. 7-9, 1 fig.

Keywords: Oxidation ditch, Electrolytic cell,
Aeration, Economics, Design

A theoretical lab-bench study was conducted to find an economical alternative to mechanical aeration of oxidation ditches. The prospect of using electrolytic oxygen, produced *in situ*, to replace mechanical aeration was studied. An electrolytic cell using Dimensionally Stable Anode (DSA) as the anode, steel as the cathode, and a cloth diaphragm sandwiched between the electrodes was constructed. The cell was operated for three 6-day periods and then dismantled for examination. Test results for the electrolytic cell were not significantly different from the aerobic tank and both were significantly different from the anaerobic tank. While these results were encouraging, calculation indicated the electrolytic cell was more expensive than mechanical aeration. Plans have been made to study ways of lowering the energy losses by reducing cell resistance. An increase in temperature is also proposed which should increase the efficiency of the electrolytic process as well as increasing the rate of single cell production. (Merryman-East Central)

5556-B1, D2, D3, E3 RECYCLED ANIMAL WASTE AS ANIMAL FEED -- RESPONSE TO FDA REQUEST FOR DATA, INFORMATION AND VIEWS

Anonymous
Livestock Waste Management Projects, Uni-
versity of Illinois, Oct., 1978, p. 6-7.

Keywords: Refeeding, Animal wastes, Food &
Drug Administration, Oxidation ditch, Chemi-
cal treatment

The Federal Register 42:248, Dec. 27, 1977, Part II was a request from the Food and Drug Administration for data, information, and views on recycled animal waste as feed. The University of Illinois responded that it supported reasonable and safe practices of using processed manure and other recoverable resources as ingredients for livestock feed. However, the university stated that guidelines are needed by producers on processing methods which will insure that these materials will not contaminate our food with undesirable chemical residues, pathogens and/or bioglycosylated compounds (such as aflatoxins). The university also stated that animal excreta, including bedding and associated materials, is more valuable as a source of nutrients for ruminants than as a fertilizer. However, since not all manure can be accommodated in livestock rations there is need for various alternatives for utilizing

manure. Research work of processing manure for feeding at the Illinois Agricultural Experiment Station in recent years has largely been in three broad areas: (1) oxidation ditch treatment of swine and poultry manure for feeding to the same animals as a fortified drinking water, (2) chemical treatment of poultry and beef manure for feeding to cattle, and (3) using swine manure as feed for fish. The research is briefly discussed. (Merryman-East Central)

5557-A11, B2, B3, E3 REFEEDING ODM L AND DRIED SWINE FECES TO SWINE

Department of Animal Science, University of Illinois, Urbana-Champaign, Illinois
A.H. Jensen and G.R. Frank
Livestock Waste Management Research Projects, University of Illinois, Oct., 1978, p. 12-14. 3 tab.

Keywords: Liquid wastes, Solid wastes, Swine waste-dried, Refeeding, Swine, Performance

Oxidation Ditch Mixed Liquor (ODML) was recycled through drinking water troughs to 96 pigs which had been wormed before placing them in the building. Tap water served as the control. Experimental diets were: (1) control diet, a fortified corn: soybean meal mixture, (2) control diet minus B-vitamin supplementation, (3) control diet minus calcium and phosphorus supplementation, and (4) control diet minus both B-vitamin and calcium and phosphorus supplementations. There were no significant differences among treatments. The data suggested that the 29-day period was insufficient to produce evidence of inadequate dietary B-vitamin or calcium and phosphorus. Longer term studies will be conducted. Another experiment was conducted to evaluate the effects of different dietary levels of dried swine feces on acceptability of the diets by young pigs. Feces were collected under a slotted-floor pen housing ten finishing pigs that had been fed a 14% fortified corn: soybean meal diet. The feces were dried in a drying oven, ground, and mixed with the diets. Levels of 2.5 or 5% of dried material replaced an equal amount of weight of yellow corn. Diets were fed either in meal or pellet form. Neither dietary level of dried feces nor form of diet significantly affected performance. (Merryman-East Central)

5558-A7, A11, B1 EFFECTS OF AIR CONTAMINANTS ON PIGS IN EXPOSURE CHAMBERS

Department of Animal Science, University of Illinois, Urbana-Champaign, Illinois
J.G. Drummond and S.E. Curtis
Livestock Waste Management Research Projects, University of Illinois, Oct., 1978, p. 19.
Keywords: Air pollution, Animal health, Swine, Performance, Ammonia

The performance trials are conducted in four dynamic type air-pollutant-exposure chambers. Young pigs (weighing 17.6 pounds at the start) were studied in three trials. Four pairs of pigs were studied in each trial. One pair served as experimental controls, while the other three were inoculated intranasally with *Bordetella bronchiseptica*. The infected pairs were exposed to aerial ammonia at 0, 50, and

100 p.p.m., respectively, for four weeks. *B. bronchiseptica* infection reduced rate of gain by 26 percent (1.01 pounds average daily gain versus .74), but exposure to aerial ammonia was without additional effect. The results are interesting because aerial ammonia at these concentrations alone depresses rate of gain and, also, the effects of aerial ammonia and ascaris are additive. (Drummond-University of Illinois)

5559-A4, B2, E3 RECYCLING ANIMAL WASTES USING A POLY CULTURE OF ASIAN AND NORTH AMERICAN FISHES

H. Buck
Livestock Waste Management Research Projects, University of Illinois, Oct., 1978, p. 19-21.

Keywords: Swine wastes, Poultry wastes, Recycling, Fish production, Lagoons, Water quality

Studies were conducted to determine the ability of various Chinese carps and an Israeli variety of the common carp to improve water quality in static ponds used as swine waste lagoons, and to produce unprecedented quantities of fish. Both objectives were achieved through the consumption by the fish of massive quantities of plankton algae and other organic materials, and their conversion into fish flesh. A 1978 objective was to measure the additional improvement in water quality to be achieved through the use of two-stage flow-through systems which exploit dense populations of fish in the first pond and which exploit macrophytic plants in the second. The second pond was to function primarily as a "polishing" lagoon. Two such two-pond units were utilized. The first pond contained four kinds of carp, received manure from swine, and had a continuous stream of flow-through water. The second pond in each unit received the effluent from the first, and was stocked with 3 varieties of duckweeds and 3 kinds of carp plus *Macrobachium rosenbergii*. The ponds will be drained and censused in October, 1978. Analyses of accumulated samples and development of the data will continue through the winter. Preliminary evaluation of the data is encouraging. A new project was initiated in 1978 which involves recycling chicken manure in 27 three-meter diameter pools containing various experimental combinations of fish. Nine also were stocked with large freshwater prawn, *Macrobrachium rosenbergii*, in addition to fish. Tests are being made of 9 different experimental populations. Fish species include silver carp, grass carp, Israeli carp, striped mullet, substrate and filled with pond water to a depth of about 52 cm. Selected pools receive 10½ hours of mechanical aeration; others receive none. A single laying hen is maintained over each of the pools selected to receive waste so that the wastes drop directly into the water. (Merryman-East Central)

5560-A8, B2, C2, E2 DISPOSAL OF LIQUID WASTE FROM A CATTLE FEEDLOT ONTO A FORESTED WATER-SHED

G.L. Rolfe and L.E. Arnold
Livestock Waste Management Research Projects, University of Illinois, Oct., 1978, p. 22.

Keywords: Feedlot wastes, Liquid wastes, Land application, Waste composition, Salts, Ammonia, Crop response

The objectives of this study were to evaluate the effects of application of feedlot liquid wastes on the germination of seeds and survival of seedlings of black, and blackjack oaks, shagbark, and mockernut hickories. Seeds were collected, examined for beetle infestation, cold stratified and then planted in Graysburg silt loam. Any water-waste runoff was redistributed on the soil surface. Treatment levels of 0, .667, 2.00, 3.33, and 4.67 (kg/ha) x 10³ dry weight equivalent were applied to the soil surface. Environmental conditions were maintained at optimum levels for growth. At the highest level of treatment for black oak 100% mortality occurred. High salt (creating osmotic stresses) or high levels of ammonia (causing direct burning), may account in part for these results. No differences were found between treatments within species in the levels of total-N, P, Ca, Mg, and K in the shoot and root portions. The total amount of nutrients found in the cotyledon may be sufficient to supply the seedlings with enough nutrients for optimum growth through most of the first growing season. The differences in levels of nutrients may point to emerging trends indicating that a longer experimental period may be needed to determine true differences in height and biomass between treatment levels. (Rolfe-University of Illinois) (Abstract only)

5561-B1 MONITORING FIELD EQUIPMENT

Department of Agricultural Engineering, University of Illinois, Urbana-Champaign, Illinois
T.M.P. Wall, D.H. Vanderholm, M.D. Hall, A.J. Muehling, and D.L. Day
Livestock Waste Management Research Projects, University of Illinois, Oct., 1978, p. 23.

Keywords: Monitoring, Waste management, Equipment

A new project has commenced of monitoring the operational parameters of several field installations. The installations include selected farms that have innovative approaches to solving waste management problems. One farm is a farrow to finish swine enterprise for producing 1,000 litters per year. The building has roof solar collectors, totally slotted floors, and the waste is removed by flushing under the slats. The wastes are pumped to a trench-type tank that may act as a plug-flow anaerobic digester, it also has a solar roof. Effluent from the digester goes to an above ground tank for flash aeration to reduce odors and then the water is recycled to flush the barn. Sludge is periodically removed from the trench tank for injecting into cropland. Another farm has a commercial trench-type anaerobic digester for the wastes from about 20,000 laying hens and a small swine feedlot. The digester has three modules, the mixing module, the bio-generator tank module, and the gas collection module. The mix module receives some active effluent from the digester tank that is mixed with incoming manure before being fed into the digester tank. The raw gas goes through a scrubber and is compressed into the gas collection module. It can be used for heating fuel or to power an electric generator. Another farm has two commercial aerator-pump units of recent,

somewhat innovative design installed in a liquid swine manure pit under a slotted floor swine finishing building with a capacity of about 500 head. This facility is on a university farm operated by a tenant and the tenant has had problems in removing settled solids from the pit, as well as experiencing odor levels within the building which he felt were objectionable. A short term program of monitoring is in progress to evaluate the characteristics of the aerators in correcting the problems described. (Wail-University of Illinois)

5562-A11, B3, C1, C2, E3 VALUE OF BROILER LITTER FOR FEEDING BEEF CATTLE

Department of Animal Sciences, University of Arkansas, Fayetteville, Arkansas
M.L. Ray
Bulletin 832, Agricultural Experiment Station, University of Arkansas, Fayetteville, Arkansas, Dec., 1978, 32 p. 29 tab., 24 ref.

Keywords: Poultry litter, Refeeding, Cattle, Waste composition, Nitrates, Performance

All tests conducted at the Arkansas Agricultural Experiment Station have indicated that rations containing broiler litter can be used successfully in beef cattle nutrition. Digestion studies with litters involving several types of base materials revealed that a litter base of cottonseed hulls, oat straw, wheat bran, or other similar plant material has more nutritive value than a base of sawdust or wood shavings. Feeding and carcass studies revealed no diseases, carcass or organ condemnations, or drug accumulation problems from feeding of litter in beef cattle rations for wintering calves or finishing beef animals. Cows suckling calves performed as well on chicken litter roughage as cows receiving grass hay. Only loose, dry litter should be used in ration formulation. An extremely dusty litter should be avoided. However, dust can be reduced by adding 2 percent fat or molasses to the ration. Each batch of litter used in ration formulation should be analyzed chemically, at least for crude protein, crude fiber, dry matter, and nitrates. Although no nitrate problems have been encountered in these studies it is recommended that rations not be formulated from litters with high nitrate analysis. Bloat has been a minor problem with rations in which the particle size was very fine. This problem was easily alleviated by feeding long hay at the rate of 2 lb (0.90 kg) per head daily. Broiler litter is devoid of vitamin A and therefore animals should be supplemented with vitamin A when litter makes up as much as 25 percent of the ration. Broiler litter is a low energy feed so beef animals should be fed additional energy according to the level of production expected. There are still unsolved questions relative to the usefulness of broiler litter as a beef cattle feed and research is continuing in this field. (Ray-University of Arkansas)

5563-B3, D1, E3, F1 LITTER REPLACES FUEL OIL IN POULTRY HOUSE HEATING

University of Maine
N. Smith, J.G. Riley, C.W. Klitridge, and N.E. Putnam

Animal Industry Today, V. 2, No. 2, p. 1-3, March-April, 1979, 6 fig., 1 tab.

Keywords: Poultry litter, Fuel, Recycling, Economics, Design

Because fuel oil has more than doubled in price in Maine since 1973 with a consequent cut back in ventilation to save fuel, poultry litter as fuel source for heating broiler houses looks increasingly appealing. Energy content of poultry litter is about 7500 BTU/lb, making its current value as a substitute for No. 2 fuel oil about \$53 per ton. University of Maine experiments have resulted in a prototype litter pellet burning furnace. The fly ash problem and the requirement for a continuous oil fuel input led the experimenters to attempt to modify the litter so it could be burned on a grate. The litter was compressed successfully into pellets by a device previously used to dewater bark from piles accumulated at a paper mill. The handling, storing and burning characteristics of pelleted litter were so attractive that a new firebox with a rotating grate to remove excess ash was constructed. Researchers have proposed that two pre-production versions of a litter pellet burning furnace, incorporating automatic controls, be built for test in two commercial broiler operations. The furnaces will be used to replace oil burners firing existing hot water boilers in the two broiler houses. One unit will be a similar size to the prototype, equivalent to a 200,000 BTU/hr oil burner, while the other will produce 1,000,000 BTU/hr, a typical size for large broiler houses. Pelleted litter for the furnaces will be produced by a prototype machine now being developed under a grant from the Maine broiler industry. About four pounds of litter is produced by each bird and less than 25 percent of that is needed to heat the broiler house in which the bird is grown. Further development of the pelleting machine may permit the remaining litter to be processed into a convenient form for use as fuel in other segments of the poultry industry. Pelleted litter may also become a salable product for fertilizer or for other fuel uses. (Merryman-East Central)

5564-B2, C2, E3 ENERGY FROM SWINE MANURE

Agricultural Engineering Dept., University of Missouri, Columbia, Missouri 65211
J.R. Fischer, E.L. Iannotti, and D.M. Sievers
Unpublished paper, Oct., 1978, 4 p. 22 r.f.

Keywords: Anaerobic digestion, Swine wastes, Methane, Design, Digesters, Recycling

This paper discusses results of anaerobically digesting swine manure. Facts and figures are given on utilization of the energy from the anaerobic digester. Design parameters and some of the biochemical changes that occur during digestion are also given. (Fischer-University of Missouri)

5565-B3, C2, D3, E3 SILAGE OF MANURE AND FINAL MOLASSES. 2. EFFECT OF DIFFERENT PROPORTIONS OF MANURE AND FINAL MOLASSES ON THE pH AND THE FORMATION OF ORGANIC ACIDS AND

ETHANOL

Instituto de Ciencia Animal, Apartado 24, San Jose de las Lajas, La Habana, Cuba
C. Hardy and A. Elias
Cuban Journal of Agricultural Science, V. 10, p. 183-189, 1978, 1 fig., 4 tab., 8 ref.

Keywords: Silage, Fermentation, Animal wastes, Refeeding, Ethanol, Organic acids, pH

An experiment was conducted to determine the effects produced on the fermentative indices of manure silage when mixtures with different proportions of manure and final molasses are ensiled. Four silages were prepared with different proportions of manure and final molasses (25/75; 40/60; 55/45 and 70/30, respectively) in laboratory silos. While there was a lower pH (P<.001) and a higher formation of organic acids (P<.001) as the manure proportions were increased, the ethanol content underwent little variation. It was concluded that high manure proportions can be used for silage with final molasses. (Merryman-East Central)

5566-C2, E2 PRODUCERS DEVISE HOG WASTE CHART

Anonymous
Hog Farm Management, V. 16, No. 4, p. 30, April, 1979, 1 tab.

Keywords: Swine wastes, Fertilizer value, Nitrogen, Phosphorus, Potassium, Sulfur

A chart of available nutrients in different types of swine facilities in Washington County, Iowa has been developed by Washington County pork producers. Percent dry matter and pounds per 1000 gal. of liquid wastes of nitrogen, phosphorus, potassium and sulfur are listed in the following respective order for farrow, nursery, finishing (pit over 1/2 full). For farrow the chart listed dry matter: 3.8; nitrogen: 28.8; phosphorus: 11.3; and potassium: 8.0. For finishing (pit over 1/2 full), the chart listed dry matter: 7.6; nitrogen: 62.3; phosphorus: 27.0; potassium: 24.3; and sulfur: 6. For finishing (pit less than 1/2 full), the chart listed dry matter: 13.4; nitrogen: 87.2; phosphorus: 35; and potassium: 27.1. (Merryman-East Central)

5567-B3, E3, F1 LITTER-FED FURNACE PROTOTYPE READY FOR TESTING

R. Smith
Feedstuffs, V. 51, No. 4, p. 29-30, Jan. 22, 1979, 4 fig.

Keywords: Recycling, Poultry litter, Fuels, Design, Economics

University of Maine agricultural engineers are experimenting with a new type of litter-fed furnace which could mean resumption of growth in the broiler industry there as well as relief from the rising cost of the oil for heating broiler houses everywhere. Fuel costs to poultry growers in Maine currently average about \$4,000 annually and are so high growers are beginning to cut back on ventilation to save fuel even though this results in increased litter moisture and, consequently, increased disease risk. After experimenting, the

engineers compressed the litter into pellets and found these pellets created ample heat and eliminated ash carryover and certain other problems. The only remaining significant problem was a buildup of ash on the grate, and this was solved by developing a rotating grate-scraping arm operation which disposed of the ash into a kind of ash pit from which it could later be removed. After a number of other modifications, including a baffle system for mixing gases, the engineers completed the prototype litter-burning furnace for testing in commercial houses. Only 25% of the litter from a flock is necessary for their furnace. The remaining 75% could be used for other fuel purposes in the poultry industry. As a fuel oil replacement, the litter's value would be about \$53 a ton. (Merryman-East Central)

5568-B3, E3 POULTRY WASTE BEING MARK- ETED FOR CATTLE FEED

Anonymous
Feedstuffs, V.51, No. 9, p. 17, Feb. 26, 1979.
Keywords: Poultry wastes-dehydrated, Re-feeding

Melvin Rich, president of Richgold Poultry Farms, Inc., has developed a feed supplement called "ProRich" which utilizes dried poultry wastes as its base. ProRich contains levels of protein ranging from 12-30% as well as vital minerals and vitamins. It is less expensive than supplements made from other bases. ProRich is being marketed throughout the western U.S. (Merryman-East Central)

5569-A4, A5, B2, B5, C1, C2, C3, D1, D3, E2 LAND APPLICATION OF AGRI- CULTURAL WASTEWATER

Department of Thermal and Environmental Engineering, Southern Illinois University, Carbondale, Illinois 62901
C.B. Muchmore, E.E. Cook, and M.J. Battaglia
Proceedings of the 31st Industrial Waste Conference, Purdue University, May 4-5 and 6, 1976, p. 676-683. 5 fig., 4 tab., 7 ref.

Keywords: Dairy wastes, Wastewater treatment, Feedlot runoff, Settling basin, Land application, Waste composition, Water pollution, Groundwater pollution

A dairy wastewater treatment facility was designed which included the following components: (1) A concrete apron to divert the flow during rainfall periods from the feedlot surface to a 624-ft³ settling basin, where settleable solids have an opportunity to be removed. (2) A screened overflow stand pipe in the settling basin to permit the liquid runoff containing suspended solids to be transferred to a 1500-gal septic tank. The waste line from the milking parlor bypasses the settling basin and enters the septic tank directly. (3) A level-activated pump (1½ hp, delivering 60 gpm) that transports the runoff to the waste utilization area, a 2.1 acre, 3% slope field that had an existing stand of tall fescue at the time of the system startup. (4) A 7.8 m (25-ft) long open-top, notched-distribution trough located at the top of the utilization area. (5) One reference and three shallow (11-13 ft) monitoring wells were constructed. Feedlot runoff

evaluation consisted of sampling the raw waste in the sump tank and determining the solids removed from the settling basin. Since the treatment system provided almost no storage capacity, the characteristics of the waste liquid applied were determined primarily by current weather conditions. It was found that dairy wastes, including feedlot runoff, could be utilized effectively by direct application of grassed areas on a year-round basis. The 2.1-acre utilization area proved adequate to accept liquid waste resulting from a 60-head dairy operation. Stream water quality standards were violated only under most heavy rainfall conditions. The settling basin removed about 35% of the solids from the feedlot runoff; 65% were carried through the system to the utilization area. The need for a settling basin may not be justified in all cases. The highly efficient denitrification performance of the saturated portion of the utilization area suggests the following design: an alternate loading on the upper slope to maintain aerobic conditions, favoring nitrification, followed by a common zone down-slope that would receive the flow from each of the aerobic zones. This arrangement could provide an effective nitrification-denitrification system thus avoiding high nitrate levels in the treated water. (Merryman-East Central)

5570-B2, B5, C2, E2 MANAGING MANURE CUTS FERTILIZER COSTS

Staff Editor, Hog Farm Management
K. Brown
Hog Farm Management, V. 16, No. 4, p. 26-30, April, 1979. 2 fig.

Keywords: Swine wastes, Liquid wastes, Land application, Waste composition

Two Washington, Iowa hogmen state their case for knifing their liquid swine wastes into cropland. They test their soil and hog manure each fall. Their fertilizer dealer takes the manure samples from their manure pits at three different levels and sends it with soil tests to a commercial lab for an analysis. The liquid manure sites are tested for nitrogen, phosphorus, potassium, sulfur, calcium and seven other trace minerals. When the results are back, the manure is knifed into the fields that need it. The manure must be well stirred before pumping because manure content varies at different levels in the pit. (Merryman-East Central)

5571-A11, B1, C1, C2, C3, E3 PERFORMANCE AND HEALTH OF CALVES FED WET CAGED LAYER EXCRETA AS A PROTEIN SUPPLEMENT

University of Guelph, Guelph, Ontario, Canada N1G 2W1
O.B. Smith, G.K. Macleod, D.N. Mowat, C.A. Fox and E.T. Moran, Jr.
Journal of Animal Science, V. 47, No. 4, p. 833-841, 1978. 1 fig., 7 tab., 48 ref.

Keywords: Refeeding, Poultry wastes, Cattle, Performance, Protein, Carcass quality, Salmonellae

Forty-eight bull calves averaging 90 kg were used in a 56-day trial to evaluate the feeding

value of wet caged layer excreta from birds fed high (HPN) and low (LPN) plane of nutrition diets and to estimate the associated disease transmitting potential. The individually penned calves were randomly assigned to four isonitrogenous diets: (1) corn silage + high moisture corn + soybean meal; (2) corn silage + high moisture corn + urea; (3) corn silage + high moisture corn + HPN-excreta. Samples of the four diets, HPN-excreta, LPN-excreta, calves feces as well as mesenteric lymph nodes, gall bladder and intestinal content taken from the calves after slaughter were cultured for Salmonellae. Rib-roasts were evaluated for flavor. HPN-excreta was higher (P<.05) in crude protein, ash and digestible dry matter, but lower (P<.05) in acid detergent fiber and neutral detergent fiber than LPN-excreta. Daily dry matter intake, average daily gains (ADG) and gains adjusted for feed intake, i.e., feed efficiency (FE) were: 4.15, 1.29, 1.24 kg; 3.85, 1.07, 1.10 kg; 3.86, 1.03, 1.05 kg; 3.93, .96, .96 kg for diets 1, 2, 3, and 4, respectively. ADG and FE differences were significant for 1 over 2, 3 and 4. FE difference between 2 and 4 was also significant. Rib-roasts were equally acceptable (P<.05) and no ill effects were observed in any of the calves, even though Salmonellae were regularly isolated from the two sources of excreta, and the excreta containing diets. (Smith-University of Guelph)

5572-A4, B2, B3, E1, E2 NEW SYSTEM CONTROLS DAI- RY WASTE

M.D. Keebler and W.F. Jones
Soil Conservation, V. 43, No. 8, p. 608, March, 1978. 2 fig.

Keywords: Dairy wastes, Liquid wastes, Solid wastes, Serpentine waterways, Waste treatment, Water pollution

John Ronhovde requested an inspection of his dairy farm east of Lincoln, Nebraska and in summer, 1976 received a notice from the Nebraska Department of Environmental Control that the operation required a livestock waste control system. The Soil Conservation Service planned a waste control system for Ronhovde which he adopted. The plan utilizes a 600 ft long, 15 ft wide grassed waterway snaking downslope at a slope of 0.4 to 2 percent from a loading shed, feed bunk, and cow lot. Runoff and liquid waste not absorbed before reaching the end of the waterway flow into a 1-acre field sink, where they evaporate or seep into the soil. The system includes a debris basin at the head of the waterway. Washwater from the milking parlor drains through a buried pipe into a holding pond that can collect 800 gallons a day for 120 days. The system is self-contained. Clean runoff is diverted from the polluted areas and into a nearby creek. Ronhovde states that he now needs to build a manure storage bin on a concrete slab for easier handling and disposal of the farm's solid waste. Such storage will keep manure from accumulating in the buildings and on the lot when weather does not permit spreading. (Merryman-East Central)

5573-B2, D3, E3 DOME-SHAPED BIOGAS PLANT

Assistant Commissioner (Biogas), Department of Agriculture, New Delhi, India
K.C. Khandelwal
Compost Science, V. 19, No. 2, p. 22-23, March-April, 1978. 2 fig., 1 tab.

Keywords: Biogas, Design, Digesters

This biogas plant is based on a successful Chinese design, which may be built at a low cost and with locally available materials in developing countries or for small operations. A materials list and a design of the plant are included, as well as a discussion of construction and finishing methods, and problems associated with these plants. There have been two such plants constructed in India for operational studies. The dome shaped plant is unique in combining the gasholder and the digester in one unit. (Solid Waste Information Retrieval System)

5574-B1 SEPARATION OF COARSE SOLIDS FROM BEEF CATTLE MANURE

USDA-DEA, AR, Clay Center, Nebraska
C.B. Gilbertson and J.A. Nienaber
Transactions of the ASAE, V. 21, No. 6, p. 1185-1188, Nov.-Dec., 1978. 4 fig., 2 tab., 10 ref.

Keywords: Separation techniques, Cattle wastes

A vibrating screen may be used effectively to remove coarse particles from diluted housed beef cattle manure with a 20- or 30-mesh screen. The 10-mesh screen is inefficient because it will remove only very small quantities of solids. Also, screen sizes with holes smaller than 500 microns (30-mesh) will reduce capacity to a point that inflow is difficult to control. The total solids content of the diluted manure must be such that the fluid will act as a liquid (approximately 6 percent solids). The total solids content of the separated solids will range from 20 to 22 percent. The separator will remove 1.3 kg of dry matter per minute on the 20-mesh screen and 1.7 kg per minute on the 30-mesh screen. It is estimated that 13 h of separation time per day will be required for a 0.61 m diameter vibrating screen to handle 1000-head-capacity housed feedlot if a 30-mesh screen is used and 8 h if a 20-mesh screen is used. Three counterweights (top and bottom) at an eccentric lead angle of 60 deg was the most efficient configuration for the 0.61 m diameter screen. Lead angles greater than 60 deg resulted in rapid circling of solids near the center of the screen and eventual screen overflow of the diluted manure, and lead angles less than 60 deg resulted in the rapid movement of materials to the outside rim of the screen without sufficient residence time for fluid to flow through the screen. (Gilbertson-USDA-DEA)

5575-B2, C2, D3, E3 RECYCLING SYSTEM IN INTEGRATED PLANT AND ANIMAL FARMING

Professor and Director of Research and Research Assistant, University of the Philip-

pinas at Los Banos, Laguna, Philippines
J.A. Eusebio and B.I. Rabino
Compost Science, V. 19, No. 2, p. 24-27, March-April, 1978. 2 fig., 2 tab.

Keywords: Recycling, Algae, Methane, Fermentation, Fertilizers, Fish production, Animal wastes, Waste composition

Basic information from research projects on a recycling system of an integrated plant and animal farm in the Philippines is presented. Five components utilized in the recycling system are: algae production, livestock/poultry production, biogas, rice-vegetable production, and inland fish production. The components are designed to complement each other, thus reducing operational costs of the integrated farming scheme. The benefits obtainable from production and use of biogas (methane) are discussed, including energy resource substitution. It was estimated that if 60% of organic wastes of farm animals were collected and utilized for methane production as an energy source, a yearly savings of 8.9 billion l of petroleum could be realized in Southeast Asia region. Ways of improving the methane fermentation process are discussed in terms of manure loading and dilution rate, retention time, and fertilization effects. Demonstration of the effectiveness of the farm recycling system is described from the test farm's reports. (Solid Waste Technical Information)

5576-B1 SELECTION OF LIQUID MANURE PUMPS FOR FARM WASTE

Ministry of Agriculture and Fisheries, Hamilton, New Zealand
A.J. Dakers
Ministry of Agriculture and Fisheries Publication, 1977, 11 p. 1 fig.

Keywords: Pumps, Waste management, Design

This New Zealand publication is a guide to selecting a liquid manure pump for a particular farm application. An attempt is made to point out some of the engineering features to be looked for in a pump. A list of pumps and their manufacturers is given, and it is suggested that details of the pumps be obtained from the manufacturer or distributor. (Merryman-East Central)

5577-A4, B2, B4 SOLID WASTE HANDLING FOR DAIRY OPERATIONS

Animal Sciences Department, Purdue University, West Lafayette, Indiana 47907
N.J. Moeller and W.H. Friday
Cooperative Extension Service Circular ID-122, Purdue University, 1976, 7 p. 11 fig., 2 tab.

Keywords: Solid wastes, Dairy wastes, Design, Housing, Feedlot runoff, Waste storage, Economics

The purpose of this publication is to help the dairy producer assess his waste handling needs, then design a solid system that will effectively and economically meet those

needs, based on type of housing. Ways of controlling feedlot and storage area runoff are also discussed. Although solid waste handling does have disadvantages, such as higher labor requirement, it is the cheapest method of manure removal requiring the lowest economic investment. With properly-installed facilities, adequate equipment and good management, a solid waste system should serve the needs of most dairy operations very well. Facilities and equipment for solid manure storage are described. The following four typical housing systems found in Indiana are described: (1) free-stall housing with open lot feeding; (2) loose housing with open lot feeding; (3) confined free-stall housing (total covered housing and feeding); and (4) stall-on-tie, comfort-stall housing (total covered housing and feeding). (Merryman-East Central)

5578-A6, B2, C2, D3, E2, E3 SWINE WASTE DIGESTER AT THE UNIVERSITY OF MISSOURI-COLUMBIA

Department of Agricultural Engineering, University of Missouri, Columbia, Missouri
D.M. Sievers, J.R. Fischer, and C.D. Fulhage
Agricultural Experiment Station Publication SR 213, University of Missouri, 1978, 17 p. 10 fig., 6 ref.

Keywords: Swine wastes, Recycling, Anaerobic digesters, Design, Odor control, Lagoons, Settling basins, Methane, Land application

Swine represents a resource that can and should be utilized on the farm to help conserve energy and fertilizer nutrients. Anaerobic digestion of swine wastes can accomplish this and control odor as well. University of Missouri at Columbia (UMC) research has shown that 60 percent of swine waste volatile solids placed in a digester will be broken down within a 15-day detention time and 0.9 liters of biogas (60% methane) produced per gram VS destroyed. It was determined that each animal would thus produce 12.6 cu.m. of methane during his 26-week stay at UMC's farm. Design and operation of the waste management system at the UMC Swine Research Farm is described in detail. Swine wastes are automatically removed from each building and transported through underground tile to a common manhole. A valve in the manhole allows the waste to be directed to an anaerobic lagoon or to a settling basin. Gutter flushing is used in the farrowing and finishing buildings and produces excess water which is placed in the settling basin where the solids settle to the bottom. Excess water is then removed and directed to the lagoon and the concentrated solids pumped into the digester. A constant liquid volume is maintained in the digester. When the liquid-solid slurry is pumped into the digester from the settling basin, a similar volume of liquid is discharged from the digester to the lagoon. It is important that the pipe carrying manure solids from the basin to the digester be sloped back to the basin so that slurry remaining in the pipe after pump shutoff can drain back to the basin. The entire waste management system is automated and controlled from an electrical control panel located in the digester equipment room. Wastes are placed into the digester once a day but could be done more frequently. It is important to collect manure at least daily if it is to be digested. Manure that is allowed to lie around uncollected begins to decay immediately, resulting in loss of potential gas production. (Merryman-East Central)

5579-A2, B2, D3 VEGETATIVE-SOIL FILTRATION HANDLES WASTE EFFICIENTLY

Anonymous
Feedstuffs, V. 50, No. 47, p. 26, Nov. 13, 1978.

Keywords: Legal aspects, Filtration, Feedlot runoff, Dairy wastes, Liquid wastes, Waste treatment, Vegetative-soil filtration

The Environmental Protection Agency has charged farmers with the responsibility of reducing pollutants to an established acceptable level before runoff enters streams. For small operators, who are just large enough to be required by law to obtain discharge permits, traditional waste water treatment systems may be too expensive. Therefore, the vegetative-soil filtration system may enjoy increased use. Southern Illinois University-Carbondale utilizes such a system on its 70-cow dairy farm. The milking parlor at this facility produces 1,200 to 1,500 gal. of liquid waste daily, and the adjoining feedlot contributes another 12,000 gal. for every inch of rainfall. At SIU-C, 4-in perforated PVC tubing handles the distribution. The lines are laid on the contour with just enough pitch to keep them flowing. Normally, the liquid flows 50 to 75 ft down the slope from the distribution lines, but it flows farther on saturated or frozen ground. (Merryman-East Central)

5580-A6, B1 WASTE REGULATIONS MUST BE REALISTIC AND FLEXIBLE

G. Osborne
Hog Farm Management, V. 16, No. 4, p. 80, April, 1979. 1 fig.

Keywords: Legal aspects, Waste management, Odor control

George Osborne, an Alta, Iowa pork producer, stresses the need of initiative on the part of the farmer to clean his own house before government intervention dictates such measures. Osborne says that a big percentage of odor problems are management related. Keeping the premises clean, knifing in manure, showing proper consideration for neighbors, and using proper ventilation will help eliminate odors and odor complaints. The location of facilities with regard to other dwellings is also important. Every state has certain prevailing winds which need to be taken into consideration. (Merryman-East Central)

5581-B1, B4 WAYS TO MOVE MANURE FROM BARN TO STORAGE

M.F. Brugger
Hoard's Dairyman, V. 123, No. 19, p. 1234-1235, Oct. 25, 1978. 3 fig.

Keywords: Waste storage, Waste management, Pumps, Barn cleaners, Flushing, Scraping

Getting manure from the barn to storage is a key item in any system involving storage outside the barn. Bedded packs and slotted

floor barns are the main exceptions. For others, manure must be collected at one location and moved to storage. Type of housing and manure handling (liquid or solid) are a determining factor. Amount and type of bedding influence how well some equipment handles manure. Where storage is located in relationship to the barn also influences selection. Other determining factors are type of storage, location of land and availability of service. Equipment which may be involved in moving manure from barn to storage includes manure pumps, barn cleaners, tractors or skid-steer loaders for scraping, mechanical free stall alley scrapers, and equipment for flushing. Some systems, such as stackers and most tractor-scraper arrangements, add manure to the top of manure already in storage. This means storage must be located adjacent to the barn which may restrict future expansion. Adding manure to the top of the pile may lead to more fly breeding control problems. Proper handling can help prevent buildup of frozen manure which, in some cases, has kept dairymen from adding more manure to the storage. Building a good base of manure before cold weather tends to minimize freezing. Careful operation can prevent freezing of paddles on a movable stacker. The stacker should be allowed to run until paddles and chute are dry during cold weather. The stacker can also be restarted a few minutes after shut-off to reduce freeze-up problems. Any removal system can work well if planned properly and installed correctly. The entire manure handling system should be considered before beginning to buy equipment. (Merryman-East Central)

5582-B2, D3, E3 FUEL AND FEED FROM CATTLE MANURE

Anonymous
Livestock, V. 57, No. 6, p. 50-51, April, 1979. 3 fig.

Keywords: Feedlot wastes, Methane, Re-feeding, Recycling, Anaerobic digesters

In October, 1978, an experimental plant began operation near Brawley, California, converting the waste from 100 feedlot steers into 7,000 cubic ft of methane gas and leaving a residue that has potential as a high-protein feed supplement. The plant, a cooperative effort by Southern California Gas Co., Pacific Gas and Electric Co. and the 35,000 head capacity Kershaw & Sons Feedlot, was designed and built by Bio-Gas of Colorado Inc., Arvada, Colorado. The plant utilizes solar energy for the major portion of its energy needs. Solar collectors utilize the sun's ultraviolet rays for heating the digester and drying residue. The methane gas produced is being used to fire a boiler in the feed mill. The residue is being used in feed trials by the University of California, Davis, to determine its quality and what proportions it can best be used in mixed concentrate feeds. (Merryman-East Central)

5583-B3 KANSAS CONTRACTOR USES SCRAPER IN NEW MONEY- SAVING APPLICATION

Anonymous
Livestock, V. 57, No. 6, p. 50-51, April, 1979. 3 fig.

Keywords: Equipment-elevating scrapers, Waste management, Feedlot wastes, Cleaning

For most of the 23 years Gene McDonell has operated his land contracting business, he followed the usual pen cleaning methods. But soon after reliable elevating scrapers came on the market, Gene started putting them to innovative use. Gene uses the Clark 110-11B scraper to clean cattle pens. The more traditional method of cleaning has been with loaders and trucks. The new system cuts clean-up time 75%. Not only does the scraper pick up the manure faster than a loader, it also builds a better pile for cattle to stand on during rain. Whatever is not used to build a pile may be taken to a central dumping ground where it is processed and sold as fertilizer. (Merryman-East Central)

5584-A11, B1 BUILD HOG FACILITIES WITH DISEASE PREVENTION IN MIND

Anonymous
Wallace Farmer, V. 104, No. 7, p. 54-55, April 14, 1979.

Keywords: Swine wastes, Confinement pens, Design, Animal health, Flushing

Swine building design can have a great impact on herd health. From a disease prevention stand point, buildings should be designed to reduce stress and improve sanitation to the greatest extent possible. Design factors to be carefully weighed and considered include type of flooring, temperature control, humidity, and waste removal. Ideally, a pig should never come in contact with manure. That's not usually possible, but complete slatted finishing floors accomplish this best. Flush systems are acceptable as long as pigs are not allowed to come in contact with the flush water. Flushing under slats is better than the open gutter system. Before building swine confinement buildings, a swine producer should seek the advice of engineers, veterinarians, nutritionists, and production specialists. (Merryman-East Central)

5585-B2, D3, E3, F1 DESIGN AND OPERATION OF A FARM-SIZE ANAEROBIC DIGES- TER FOR SWINE

Bioengineering Unit, Agricultural Research Service - USDA, Columbia, Missouri
J.R. Fischer, N.F. Meador, D.M. Sievers, C.D. Fulhage and E.L. Iannotti
Paper No. 77-4052, American Society of Agricultural Engineers, 1977 Annual Meeting, North Carolina State University, June 26-29, 1977, 19 p. 11 fig., 2 tab., 19 ref.

Keywords: Anaerobic digesters, Design, Swine wastes, Settling basin, Lagoons, Anaerobic, Economics, Biogas

The anaerobic digester has operated stably over a period of 27 weeks. Organic loading to the digester has varied greatly but caused no apparent problems. Average loading rate over the 27 weeks has been 2.1g VS/L/day (0.13 lbs. VS/ft³/day) and produced the following

the following chemical conditions in the digester: COD-8200 mg/l, VS-8000 mg/l, pH-6.8, alkalinity-2100 mg/l, $\text{NH}_3\text{-N}$ -380 mg/l. The bacterial population was 5.6×10^7 organisms/milliliter. Gas agitation three times daily (40 minutes each time) has proven more than sufficient to prevent scum formation. Daily energy requirements for agitation has been 5 kw-hrs. Normal levels of feed additives and antibiotics fed to the hogs have caused no problems. The use of gutter flushing in the buildings and a settling basin to concentrate solids has enabled the digester to be totally automated into the swine farm operation. The largest mechanical problem associated with the system has been the difficulty of solids resuspension in the settling pit. Mechanical agitation proved to be much more satisfactory than agitation by pumping. (Fischer-ARS-USDA)

5586-B2, C2, D3, E3 ALGAE PRODUCTION AS A COMPONENT OF A SWINE WASTE NUTRIENT RECOVERY SYSTEM

Department of Agricultural Engineering, Oregon State University, Corvallis, Oregon 97331
J.R. Miner, E. Gasper, L. Boersma and H.K. Phinney
Technical Paper No. 4121, Oregon Agricultural Experiment Station, Oregon State University, 1976, 1 p.

Keywords: Algae, Swine wastes, Refeeding, Nitrogen

A system for investigating the growth of biomass on dilute swine manure has been designed and constructed. Data gathered suggest that for algae production, nitrogen and organic matter concentrations must be kept lower than anticipated to prevent overgrowth by bacteria. During the next year, the growth of both algae and bacteria will be studied and feeding trials are planned for both products. The potential of the concept seems evident but operational problems dictate that further work be done. (Miner-Oregon State University)

5587-B3, C1, C2, D1, D3, E3 PROCESS FOR THE AEROBIC CONVERSION OF POULTRY MANURE INTO HIGH-PROTEIN FEEDSTUFF

School of Chemical Engineering, Cornell University, Ithaca, New York 14853
M.L. Shuler, E.D. Roberts, D.W. Mitchell, F. Kargi, R.E. Austic, A. Henry, R. Vashon, and H.W. Seeley, Jr.
Biotechnology and Bioengineering, V. 21, p. 19-38, 1979, 6 fig., 5 tab., 32 ref.

Keywords: Refeeding, Poultry wastes, Aerobic, Poultry, Separation techniques, Fermentation, Waste composition, Performance

A two-stage aerobic continuous process is suggested for the conversion of poultry waste into a single cell protein (SCP) product. The technical feasibility of the process is examined in this paper. Using bench-scale apparatus the approximate growth kinetics have been discovered. Possible modes of product recovery have been examined. The product consists primarily of a strain of *Pseudomonas fluorescens* which has a lysine-

rich (~9.3%) amino acid profile that could make this product an attractive feed ingredient for poultry diets. (Shuler-Cornell) (Reprinted by permission of John Wiley & Sons, Inc.)

5588-C2, E2 AMMONIA VOLATILIZATION OF WINTER SPREAD MANURE

Agricultural Engineering Department, Cornell University, Ithaca, New York
T.S. Steenhuis, G.D. Bubenzer, and J.C. Converse
Transactions of the ASAE, V. 22, No. 1, p. 152-157, 161, Jan.-Feb., 1979, 6 fig., 5 tab., 23 ref.

Keywords: Ammonia, Volatilization, Land spreading, Mathematical models

Laboratory and field experiments were conducted to determine ammonia volatilization rates from winter spread manure. Factors considered were manure application rate, freeze-thaw cycles, dehydration, and the urea-ammonium conversion rate. Freezing did not increase the volatilization rate. Drying was not required for volatilization. A mathematical model describing ammonia volatilization rates from land applied manure was developed. (Steenhuis-Cornell)

5589-B1 DECISION TOOLS FOR DAIRY MANURE HANDLING SYSTEMS' SELECTION

Agricultural Engineering Department, University of Tennessee, Knoxville, Tennessee
L.M. Saffley, Jr., D.A. Heath, and D.R. Price
Transactions of the ASAE, V. 22, No. 1, p. 144-151, Jan.-Feb., 1979, 14 tab., 25 ref.

Keywords: Dairy wastes, Computer models, Waste management

Two linear programming models have been developed to assist dairy farmers in managing their manure. One model is designed to select the optimum manure handling system from a group of feasible alternatives given the resources of a particular farm. The second model determines the optimum manure management policy in context with the entire dairy enterprise. (Saffley-University of Tennessee)

5590-B2, C2, C3, D3 BACTERIAL RESPONSE TO SALTS IN AN ANAEROBIC DAIRY LAGOON

Agricultural Engineering Dept., University of Missouri-Columbia, Columbia, Missouri
D. Georgakakis and D.M. Sievers
Transactions of the ASAE, V. 22, No. 1, p. 162-168, Jan.-Feb., 1979, 10 fig., 3 tab., 12 ref.

Keywords: Dairy wastes, Lagoons, Anaerobic, Salts, Toxicity, Waste composition, Bacteria, Electrical conductivity

The objective of this study was to develop the electrical conductivity parameter as a field tool in measuring the effect of salt accumulation on biological activity in livestock lagoons. Various concentrations (0.02N-0.8N) of Na, K, Mg, Ca, and NH_4 were added as chloride salts to samples of sludge and effluent taken from an active anaerobic dairy lagoon. The salt-

sludge effluent mixtures were placed into small biological reactors where gas production over a 24-h period was monitored. Salt concentrations were expressed as electrical conductivities. The relationship between biological activity in an anaerobic dairy lagoon as affected by the addition of increasing amounts of the cations Na, K, Mg, Ca, and NH_4 can be expressed by the general equation, $Y = \frac{aX}{a+X}$, where Y = the biological activity, X = the electrical conductivity, and a and b = constants. This equation can be used as a model for managing salt concentrations in dairy lagoons. From the model, it appears that the salt content in a dairy lagoon should be managed to maintain an electrical conductivity, and a and b = constants. This equation can be used as a model for managing salt concentrations in dairy lagoons. From the model, it appears that the salt content in a dairy lagoon should be managed to maintain an electrical conductivity in the range of 4.0-8.0 mmhos/cm. Allowing the salt content to exceed an electrical conductivity greater than 10-13 mmhos/cm could result in a large reduction in biological activity. The toxicity order of the cations tested was found to be (increasing toxicity): Ca, Mg, Na, K, NH_4 . The order of toxicity appeared to be strongly influenced by the effects of antagonism and synergism. (Georgakakis-University of Missouri)

5591-B3, E2 TIME-MOTION ANALYSIS OF FEEDLOT MANURE COLLECTION SYSTEMS

Texas Agricultural Extension Service, Texas A&M University, College Station, Texas
J.M. Sweeten and D.L. Reddell
Transactions of the ASAE, V. 22, No. 1, p. 138-143, Jan.-Feb., 1979, 4 fig., 11 ref.

Keywords: Time-motion analysis, Feedlot wastes, Waste collection, Equipment-collection, Energy consumption, Land spreading

Machine productivity, energy consumption and cost of feedlot manure collection were determined by time-motion analysis at four Texas cattle feedlots. Truck loading, hauling, and spreading time requirements were also determined, as was the performance of wheel loader operators. The wheel loader/chisel plow combination produced the highest manure collection rate of 180 t (metric tons)/h (at 100 percent operation efficiency), followed in order by the elevating scraper, wheel loader, and wheel loader/rototiller. The most energy efficient collection system was the elevating scraper (0.88 kWh/t). Plowing of the manure pack before the wheel loader collection reduced overall energy consumption by 30 percent and increased the collection rate by 46 percent. The average rate of manure loading into spreader trucks was 186 t/h or 3.0 min per truck. Performance of wheel loader operators varied by 85 percent. A prediction equation for spreader truck loader operators varied by 85 percent. A prediction equation for spreader truck turn-around time versus haul distance was developed. (Sweeten-Texas A&M University)

5592-B2, C2, D1, D3 MICROBIAL PROCESSING OF POULTRY MANURE FOR FEEDING TO POULTRY

Department of Poultry Science, Cornell University, Ithaca, New York 14853
R.E. Austic, A.E. Henry, M.L. Shuler, F. Kargl, H.W. Seeley, Jr., and R. Vashon
Poultry Science, V. 57, No. 4, p. 1116, July, 1978.

Keywords: Fermentation, Poultry wastes, Slurries, Centrifugation, Ammonia, Aerobic, Protein, Refeeding, Calcium, Phosphorus

A two-stage aerobic continuous fermentation process generating a high protein product from hen manure was developed on a laboratory scale. Slurried manure was subjected to fermentation by native microflora in the first stage. Ammonia generated from uric acid in the first stage was utilized in the production of bacterial cells in the second stage. The latter was essentially a pure culture of *Pseudomonas fluorescens*, with less than 5% of the biomass composed of other organisms. Product obtained from second stage was separated by centrifugation into a creamy cellular biomass (SCP) and a coarser material containing cellular and undigested material. The SCP contained approximately 40% true protein, 10% fat, 15% ash, 1.7% phosphorus, and 2.0% calcium, respectively, on a dry basis, whereas the coarse material contained 28, 7, 13, 2.4, and 3.4% respectively. Analysis of the SCP revealed an excellent profile of amino acids: lysine in excess of 8.5% of protein; methionine, 2.5 to 2.9% of protein, and cystine, .4% of protein. The coarse material contained a similar profile of amino acids though slightly less lysine than the SCP. These studies indicate that manure can be upgraded through controlled fermentation to a high protein material which may have potential value in the feeding of monogastric animals. (Austic-Cornell University) (Abstract only)

5593-A11, B3, C2, C3, E3 DRIED POULTRY MANURE AS A POULTRY FOOD

D.J.W. Lee
World's Poultry Science Journal, V. 30, p. 309, 1974.

Keywords: Poultry waste-dehydrated, Refeeding, Waste composition, Protein, Calcium, Phosphorus, Bacteria, Performance, Poultry

Analysis of various samples of dried poultry manure (DPM) from caged layers show that the approximate levels of those constituents which may be of use to the fowl are: - true protein - 11%, ME - 1000 kcal/kg dry matter, calcium - 9.5% and phosphorus - 2.0%. The levels of trace elements were such that at reasonable levels of inclusion in diets (20%) none are likely to be toxic. The numbers of organisms found upon bacterial examination were low and *Salmonella* species were not detected. DPM fed to broilers at 5 or 10% of the diet, to replacement pullets at 5% of the diet between 6 and 12 weeks of age and to layers at 10 or 20% of the diet did not have any deleterious effects on performance. In these experiments DPM was used as a dietary ingredient, not as a diluent in that the true protein, energy, calcium and phosphorus content of the DPM was used in the formulation of the diets. (Lee)

5594-B3, C2, D2, E3 A PILOT PLANT STUDY OF

SYNTHESIS INTERMEDIATES FROM FEEDLOT WASTE

R.L. Peterson
M.S. Thesis, Department of Chemical Engineering, Texas Tech University, Dec., 1975, 80 p. 18 fig., 3 tab., 17 ref.

Keywords: Feasibility studies, Pyrolysis, Design, Solid waste reactors, Ammonia synthesis gas, Methane, Gases, Temperature, Char

This study is the second phase of a manure disposal scheme known as the Syn Gas project. The first phase was initiated in 1972 by a paper evaluating the possible uses for manure from the thermochemical standpoint. A project was then funded to construct and operate a bench scale reactor. Operation of the bench scale reactor indicated that the production of ammonia synthesis gas from feedlot wastes was feasible. To determine the actual feasibility of operating on a commercial basis and to provide scale up data, it was decided that a relatively large demonstration plant should be required. Construction and operational characteristics of this reactor system are given with the intent of giving a prospective design engineer an insight into the problems and behavior that can be expected in a commercial manure pyrolysis unit. Also, data obtained from this study indicate guidelines for design of future solid waste reactors, along with new prospects for the utilization of manure. Specific conclusions resulting from the study were: (1) It was determined that the basic partial oxidation technology developed on the small scale reactor could be applied at a larger scale to produce a useful synthesis gas. (2) Effluent gas composition was influenced by the reactor temperature profile. (3) On the basis of average reactor temperatures, the raw gas generation rates from the large and small reactors were similar. (Merryman-East Central)

5595-A2, B4, B5, E2, F2 APPLICATION OF CONTINUOUS WATERSHED MODELLING TO FEEDLOT RUNOFF MANAGE- MENT AND CONTROL

Kansas State University, Manhattan, Kansas 66506
J. Zovne and J.K. Koeliker
Environmental Protection Agency Report EPA-600/2-79-085, Mar., 1979, 156 p. 21 tab., 102 ref.

Keywords: Model studies, Irrigation, Animal wastes, Feedlot runoff, Runoff control, Design, Land application, Legal aspects

A continuous simulation, digital computer, hydrologic model of feedlot runoff generation and disposal has been developed at Kansas State University. The purpose of the model is to establish guidelines and design parameters for feedlot runoff control facilities which will meet the requirements of the Federal Water Pollution Control Act Amendments of 1972. The model continuously monitors the water budget of a feedlot storage pond-irrigation disposal area control system using historic rainfall and temperature data. It uses only readily available climate, soil, and crop data so that it can be applied to all major livestock producing areas of the United States. The model is expected to be useful in evaluating applications for "permits" to discharge and for 206 planning agencies in

"Best Management Practices" for feedlots. A user manual is included with program printout, input data requirements, and an example of a 25-year simulation for Belleville, Kansas. A report on the state-of-the-art of modelling the quality of feedlot runoff is also presented. This report resulted from a meeting of specialists to pool resources on water quality modelling from their respective specialty areas. (Zovne-Kansas State University)

5596-A8, E2 EFFECT OF NITROGEN, PHOS- PHORUS AND POTASSIUM FER- TILIZERS AND FARM MANURE IN LONG-TERM EXPERIMENTS WITH ROTATION CROPS IN NORWAY

Agricultural University of Norway, 1432 As NLH, Norway
G. Uhlen
Annales Agronomiques, V. 27, No. 5-6, p. 547-564, 1978. 9 tab., 11 ref.

Keywords: Land application, Animal wastes, Fertilizers, Carbon, Nitrogen

Some results from long-term fertilizer experiments at Moystad, Voll and As (Norway) are presented. A 6 to 7 course rotation with 3-4 years arable crops and 3 years clover-limothy ley has been carried through. The yield on the non-treatment plots at Voll and As went down to 50 p. 100 or less of that of the comparison NPK-treated plots in about 25 years. Correspondent figures for the unmanured Moystad plots, however, were 70-80 p. 100. The most limiting nutrient element in unmanured soils has been phosphorus at Moystad and Voll, whereas potassium deficiency caused the greatest yield losses in the last rotational period at As. The somewhat higher yielding capacity of the untreated soil at Moystad compared to Voll and As, was not explained by chemical analytical figures of the top soil layers. Compared to the non-treatment, farm manure gave higher nitrogen and carbon percentages of the soil. Roughly calculated, about 25-20 p. 100 of the nitrogen and 17 p. 100 of the carbon in the added manure could be left in the soil after 30-50 years. A small increase in soil nitrogen and carbon resulted from moderate fertilizer applications, whereas a fifty years application of heavy NPK-doses at Moystad gave as high C and N percentages of the soil as did farm manure. Farm manure increased C/N ratios of the Moystad soil. Leaving out the NPK-fertilizer resulted for many of the rotation crop members in a high nitrogen percentage of the dry matter yield, and did not lead to a nitrogen poor type of organic matter in spite of large net removals of nitrogen. (Uhlen-Agricultural University of Norway)

5597-B3, C1, C2, E3 SLUDGE EVALUATION

R.A. Zinn, F.N. Owens, and R.P. Lake
Animal Science Research Report, MP-104, Beef and Dairy Cattle, Swine, Sheep, Poultry and their Products, Agricultural Experiment Station, Oklahoma State University and USDA, April, 1979, p. 35-38. 3 tab.

Keywords: Refeeding, Cattle wastes, Sludge, Cattle, Waste composition, Nitrogen, Ash, Palatability

Metabolism experiments were conducted with four mature steers in a crossover design experiment, to evaluate the digestibility of sludge, the residue of a process which recycles cattle waste to generate methane. Sludge was fed at 15 or 30 percent ration dry matter. At either level, animals were very reluctant to consume feed. Apparent digestibility of sludge dry matter, organic matter, acid detergent fiber and nitrogen was 20, 45, 17, and 25 percent, respectively. In another study, the digestibility of sludge in the rumen was estimated. This technique estimated sludge organic matter and fiber digestibilities at 36 and 41 percent. (Zinn-Oklahoma State University)

5598-B1, C1, C2, D3, E3 COMMERCIAL SNG PRODUCTION FROM FEEDLOT WASTES

Director of Systems Development, Thermotronics, Inc., Oklahoma City, Oklahoma
G.W. Meckert, Jr.

Symposium Paper, "Fuels from Biomass", IGT Conference, Washington, D.C., Aug., 1978, 12 p.

Keywords: Feedlots, Cattle wastes, Thermotronics, Calorific, Separation techniques, Anaerobic, Digesters, Recycling, Methane, Refeeding, Fertilizers, Design

The Calorific project in Guymon, Oklahoma is a bio-conversion plant, utilizing about 500 tons a day of cattle manure to produce cattle feed, methane gas and fertilizer. The process involves slurrying of manure from conventional feedlot pens and "selective extraction" of the products. Cattle feed is extracted by screening and dewatering; biogas is produced in large, anaerobic reactors and scrubbed to give pipeline quality methane; and reactor effluent is centrifuged to produce a high protein sludge and a liquid fertilizer concentrate. Process and equipment have been designed to achieve operational and energy efficiency. Most of the equipment has been commercially available but some was site fabricated. Construction and a phased start-up were achieved as scheduled although weather and quality of feedstock caused considerable operational difficulties. The first six months of operation have necessitated some modifications. The cattle feed product, a roughage material has been tested and proven valuable in a 1,600 head feed trial. Delivery of pipeline quality gas to a utility began on April 1, 1978. Tests are currently being conducted on the high protein sludge material and the liquid fertilizer. Several areas of investigation are required to enable widespread development of plants but Calorific is presently looking at eight additional plant sites. (Meckert-Thermotronics, Inc.)

5599-B1, D3 INFLUENCE OF FEEDING CELLS OF LACTOBACILLUS ACIDOPHILUS ON THE FECAL FLORA OF YOUNG DAIRY CALVES

B.B. Bruce, S.E. Gilliland, L.J. Bush, and T.E. Staley
Animal Science Research Report, MP-104, Beef and Dairy Cattle, Swine, Sheep, Poultry and their Products, Agricultural Experiment Station, Oklahoma State University and USDA, April, 1979, p. 207-209. 2 tab., 7 ref.

Keywords: Faecal coliforms, Cattle wastes, Lactobacillus Acidophilus, Lactobacilli

Newborn dairy calves were removed from their dams after nursing one time. All calves received one additional feeding of colostrum. They were then placed on a diet of pasteurized milk or non-fermented pasteurized milk containing a culture of *Lactobacillus acidophilus* of human intestinal origin or one of calf intestinal origin. During 14-day feeding periods, the numbers of lactobacilli in the feces of calves being fed *L. acidophilus* increased greater than in feces of control calves. The culture of calf origin caused the greatest increase. The increase in numbers of lactobacilli were accompanied by decreases in numbers of coliforms in the feces. The *L. acidophilus* of human origin caused the greatest decrease in numbers of coliforms. (Bruce-Oklahoma State University)

5600-B5, C2, E2 THE COMPOSITION OF MINERALS IN THE EXCRETA OF ADULT DAIRY CATTLE AND ITS RELATIONSHIP TO THAT OF GRASS

Environment Division, National Grassland Research Institute, Nishinasuno, Tochigiken, Japan

T. Tsuji and O. Haramaki
Journal of Japanese Society of Grassland Science, V. 22, No. 2, p. 66-94, July, 1976. 2 fig., 8 tab., 5 ref.

Keywords: Land application, Grasslands, Cattle wastes, Minerals, Potassium, Phosphorus, Calcium, Magnesium

In order to obtain some information on the cycling of minerals in grasslands, composition and recovery of minerals in the excreta of adult dairy cattle (Holstein cows) were determined on the materials collected from the digestibility trials in stalls. Particular attention was given to the relationship between minerals in grasses and those in faeces. In the first experiment, materials were collected from dry cows in June, August and October, 1971. Minerals such as iron, manganese, copper and zinc were recovered in distinctly high amounts in the faeces collected in August. In the second experiment in July and October, 1972, composition and recoveries of minerals in the faeces, urine and milk were compared between dry and lactating cows. Calcium and phosphorus contents in the faeces and chlorine content in the urine from lactating cows were lower than those from dry cows. The mineral contents in the urine varied among individual cows. In July, the total amount of iron in the faeces, urine and milk still had a trend of being recovered more than 100 percent. It was also observed that potassium recovery in October was higher than that in July, and that its higher recovery was found mainly in the urine. Mineral components both from grasses and faeces were compared. Contents of such major faecal minerals with more than 80 percent recovery as phosphorus, calcium and magnesium were 1.9 times as much as those of grasses. Contents of faecal trace elements with 100 percent or more recovery, however, were 2.3 times as much as those of grasses. (Tsuji-National Grassland Research Institute)

5601-A6, B2, C2, D3 CONVERSION OF ANIMAL WAS-

TES INTO PROTEIN AND HYDROGEN

Agricultural Engineering Department, University of Illinois, Urbana-Champaign, Illinois 61801

H.C. Kim, T.J. Greninger, D.L. Day and M.P. Steinberg

Proceedings: Fourth Inter-university Energy Conference - Policy, Energy Conservation and Other Renewable Energy Sources, University of Illinois at Urbana-Champaign, April 26-28, 1977, 13 p. 6 fig., 2 tab., 16 ref.

Keywords: Oxidation ditch, Electrolysis, Aeration, Hydrogen, Protein, Nitrogen, Odor control

The technical feasibility of replacing mechanical aeration of oxidation ditches with electrolysis of water in the wastes was investigated. Preliminary experiments made with a bench scale electrolytic cell using ODM as feed were conducted. The first test used a stainless steel sponge as the anode in order to provide a high area giving a low current density for the oxygen production. Carbon rod was used as the cathode for hydrogen evolution. Subsequent tests used other electrode combinations including steel wire, stainless steel plate, charcoal, Ni-Cr wire, and copper wire in the electrodes. In each case the fermenting liquor was free of any anaerobic odor indicating aerobic conditions. Dissolved oxygen could be detected in all cases except when the anode was charcoal. Small amounts of H_2 and CO_2 gas were detected coming from the cathode by gas chromatography. The anodes used thus far have lasted only 3-4 days; so much dissolved that the current fell and the fermentation became anaerobic as detected by smell, by Dissolved Oxygen Meter and by Redox Potential measurement. The cell will be redesigned to allow for continuous operation. Diluted waste will be added continuously to the electrolysis cell at a constant rate with constant overflow. The anode will be activated carbon and the cathode will be carbon rod. The voltage and amperage will be varied. Throughput rate will be studied. Protein production, nitrogen utilization, odor control and hydrogen production will be determined to find optimum conditions. The power input per unit single cell protein and hydrogen produced will be calculated and the values obtained will be used to make economic balances. This electrochemical oxidation will be compared to the present oxidation ditch performance on an economic basis. (Kim-University of Illinois)

5602-A8, B1, B2, C1, D1, E2 INFILTRATION OF LIQUID DAIRY MANURE INTO SOIL

Agricultural Engineering Department, Pennsylvania State University, University Park, Pennsylvania

W.R. DeTar
Transactions of the ASAE, V. 22, No. 3, p. 520-528, May-June, 1979. 10 fig., 6 tab., 3 ref.

Keywords: Infiltration, Dairy wastes, Soil response, Liquid wastes, Infiltrimeters

Basin infiltrimeters and double-ring infiltrimeters were used on the subsoil of four different soils to determine the infiltration rate of various concentrations of liquid dairy manure. Raw manure was diluted with water by ratios varying from 3:1 to 50:1. The liquid used for most of the tests did not contain the heavy fibers that tend to settle out immediately.

tely after mixing. Total solids, S_t , was the primary measure of concentration, and steady-state infiltration with water, I_w , was the indicator used for the type of soil. It was found that the infiltration rate was proportional to $I_w^{0.11}$ 8-0.67 at one week. All tests were conducted in the field and thus the results were subject to temperature effects. It was found that the infiltration rate decreased sharply with a rise in temperature, a result which is contrary to the normal behavior of water in soil. (DeTar-Pennsylvania State University)

5603-A11, A12, B2, B4, C2 MANURE GASES ARE DANGEROUS

Department of Agricultural Engineering, The University of Alberta, Edmonton, Alberta, Canada T6G 2G4
J.B. McQuitty and J.J.R. Feddes
Agriculture and Forestry Bulletin, V. 1, No. 1, p. 10-14, 1978. 1 fig., 1 tab., 10 ref.

Keywords: Liquid wastes, Gases, Animal health, Public health, Waste storage, Waste management, Carbon dioxide, Methane, Ammonia, Hydrogen sulfide

Anaerobic decomposition of liquid manure may result in production of CO_2 , CH_4 , NH_3 , and H_2S . High concentrations of H_2S are lethal and have been responsible in deaths in both humans and animals. High concentrations of CH_4 are explosive and have been responsible for loss and damage of property. Low to intermediate levels of H_2S and NH_3 can be detrimental to animal health and performance. These dangers and detrimental effects can be combated by good waste management practices. Rapid removal of manure from confinement buildings to outside storage will eliminate some of the gas risks. Exhausting air from below slat level appears to reduce risks associated with pits or tanks designed within barns to store manure for longer than a few weeks. Good air-inlet design to ensure thorough air mixing and desirable air-flow patterns within confinement buildings is important also. The air-flow patterns should ensure that gases generated by the manure are moved away from rather than toward the animals. Considerable research has been directed toward creating conditions in liquid manure which favor aerobic decomposition, including mechanical aeration. Lime and iron compounds have also been experimentally introduced for control of noxious gases. It will be some time before the worth of such methods can be established in terms of practicality and economics. (Merryman-East Central)

5604-A3, B1 THE APPLICATION OF LINEAR PROGRAMMING TO RUN-OFF MANAGEMENT

National College of Agricultural Engineering, Silsoe, Bedford, United Kingdom
M.F. Potter, R.P.C. Morgan and D.H. Noble
Journal of Environmental Management, V. 6, p. 43-55, 1978. 4 tab., 30 ref.

Keywords: Agricultural runoff, Runoff control, Model studies, Computer models

A linear programming model is presented and solved for the purpose of controlling runoff by land use management in small catchments. The problem is presented as:

$$\text{minimize } Z = \sum_{t=1}^T \sum_{i=1}^I Q_{cit} A_{cit} \\ \text{c=1 } i=1 \text{ t=1}$$

where Q is the runoff per unit area for the c th compartment (land unit) under the i th land use activity in the t th time period, and A is the area of the c th compartment under the i th land use activity in the t th time period. The model is demonstrated with constraints placed on the total area of each land unit, prescribed areas for selected land use activities, continuity (where appropriate) of land use activities over several time periods, and available resources of labor and capital (optional). Only a limited attempt at using the model with observed data has been possible so far but, its potential has been demonstrated with arbitrary values. (Merryman-East Central)

5605-B2, B3, C2, D2, D3 CHEMICAL FLOCCULATION AS A TERTIARY TREATMENT FOR PIG EFFLUENT

Ministry of Agriculture, Fisheries and Food, Soil Science Department, ADAS, Trarsgoed, Aberystwyth SY23 4 HT, U.K.
W.J. Beer and D.F. Gibbs
Water Research, V. 9, p. 1047-1050, 1975. 2 fig., 6 ref.

Keywords: Biological treatment, Swine wastes, Activated sludge, Aerobic, Anaerobic, Flocculation, Ferric chloride, Hydrated lime, Phosphorus

The system described in this paper is basically a conventional biological activated sludge plant, comprising a primary settling or anaerobic tank (91 m³), an aeration tank (45 m³) with a Simcar surface aerator 4 kg per h O_2 output, and a final settling tank (36 m³). Ferric chloride was used as a flocculating agent and hydrated lime as a floc conditioner in tertiary treatment for the effluent from the activated sludge plant which treated waste from a swine breeding and fattening unit. The rapid settling property of the conditioned floc enabled separation by simple hydraulic means in 4-6 hours, producing a clear effluent meeting Royal Commission standards for BO_5 and suspended solids. The effluent was almost phosphorus free. (Merryman-East Central)

5606-A8, B2, B3, C2, E2 POTASSIUM ACCUMULATION AND MOVEMENT IN AN IRRIGATED SOIL TREATED WITH ANIMAL MANURES

P.F. Pratt and A.E. Laag
Soil Science Society of America Journal, V. 41, No. 6, p. 1130-1133, 1977. 3 fig., 3 tab., 19 ref.

Keywords: Agricultural runoff, Salinity, Land application, Dairy wastes, Potassium, Cations

Data is presented for the accumulation and downward movement of potassium added as manure to an irrigated sandy loam soil during a 4-year field experiment. The treatments consisted of a check, which received no manure and no fertilizer (irrigation water only); 40, 79, and 158 metric tons/ha/year of solid dairy corral manure; and 21 and 42

metric tons/ha/year of liquid manure (both on a dry weight basis). The solid manure averaged 80% dry matter, whereas the liquid manure averaged 11% dry matter. The dairy manure averaged 3.1% K (range of 2.4 to 4.8%) and liquid manure averaged 3.3% K (range of 2.5 to 4.1%) on a dry weight basis. Soluble potassium accumulated in the soil in proportion to the amount of manure added and reached a maximum of 36.5% of the total soluble cations in the saturation extract of the surface layer of the plots that received the highest rate of manure. The maximum exchangeable potassium was found in the 30- to 60-cm depth of the same plots. The potassium fixed in the soil appeared to be greater than the reduction in CEC. The complete retention of potassium in the root zone of the Hanford soil, even when treated with four times as much manure as might be used efficiently as a fertilizer, indicated that potassium does not contribute to salinity in drainage waters. (Merryman-East Central)

5607-A11, C2 COMPARISON OF THE DAILY ENDOGENOUS FAECAL MAGNESIUM EXCRETION FROM SHEEP EATING GRASS WITH HIGH SODIUM OR HIGH POTASSIUM CONCENTRATIONS

Department of Animal Physiology and Nutrition, University of Leeds, Leeds, England
G. Powley, A.D. Care and C.L. Johnson
Research in Veterinary Science, V. 23, No. 1, p. 43-48, 1977. 1 fig., 3 tab., 21 ref.

Keywords: Sheep wastes, Magnesium, Waste characteristics, Grasses, Sodium, Potassium, Animal health, Hypomagnesemia

Experiments were conducted to show the effects of different levels of sodium and potassium in grass upon daily fecal magnesium excretion and the true availability of magnesium to sheep. A simple cross-over design experiment was conducted utilizing two sheep. The isotope dilution technique using ^{25}Mg was employed. The sheep ate sodium fertilized grass containing 0.15 percent sodium and 3.12 percent of the total fecal magnesium output. The true availability of magnesium was greater in the sodium fertilized grass than in the potassium fertilized grass. Experimental results indicated that daily endogenous fecal magnesium excretion was not affected by altering the herbage levels of sodium and potassium. (Merryman-East Central)

5608-B3, C1, C2, E3 EFFECT OF FEEDING POULTRY DROPPING-MAIZE SILAGE ON GROWTH RATE AND NUTRIENT UTILIZATION IN CROSS-BRED CALVES

Indian Veterinary Research Institute, Izatnagar 243 122, India
B.N. Rao, S.K. Ranjhan, and D.V.G. Krishna Mohan
Indian Journal of Animal Science, V. 47, No. 10, p. 613-616, Oct., 1977. 2 tab., 11 ref.

Keywords: Refeeding, Poultry wastes, Cattle, Performance

A 7-week investigation was conducted to see if silage prepared out of 50 parts green maize, 40 parts poultry droppings and 10 parts molasses on fresh basis, and fed *ad lib.* could be used as a sole feed for growing cross-bred calves. A control group was fed concentrate mixture, wheat straw and green fodder. Calves in the experimental group lost about 66.0 g of body weight per day, whereas calves in the control group gained about 421.8 g of body weight per day. Loss of body weight in experimental calves might have been due to their lower intake of digestible crude protein and metabolizable energy than the calves on conventional rations. Study results indicated that the silage prepared as such was not sufficient to support growth in calves, when over 50% of poultry droppings were added to the green maize fodder on dry matter basis. It was felt that with the supplementation of energy-rich feeds, the silage could form a growth production ration for cross-bred calves. (Merryman-East Central)

5609-B2, C1, C2, C3, D3, E3 PRODUCING METHANE GAS FROM SWINE MANURE IN A PILOT-SIZE DIGESTER

USDA, SEA, University of Missouri, Columbia, Missouri
J.R. Fischer, E.L. Iannotti, J.H. Porter, and A. Garcia
Transactions of the ASAE, V. 22, No. 2, p. 370-374, Mar.-Apr., 1979. 2 fig., 6 tab., 26 ref.

Keywords: Swine wastes, Anaerobic, Digesters, Methane, Waste composition, Ammonia, Nitrogen, Phosphorus, Potassium, Bacteria, Volatile solids

A 0.45m³ digester, loaded at 4 gVL/L-day with a detention time of 15 days, was operated stably at 35°C for 351 days with the following results: (1) Gas production was 2.3m³/m³ day of digester volume at 0°C and atmospheric pressure, a greater value than published values. (2) Solids destructions were 55 percent of the TS and 63 percent of the VS. (3) Ammonia concentrations of 3000 mg/L did not inhibit gas production. (4) The nitrogen, phosphorus, or potassium content of the influent and effluent was not significantly different (paired t-test, $\alpha=0.05$). (5) The total number of organisms in the digester was 2.37×10^4 bacteria/mL. (6) For each kilogram of VS destroyed in the digester 0.9m³ of gas was produced; for each kilogram of VS added to the digester, 0.56m³ of gas was produced. (Fischer-USDA)

5610-B2, C1, C2, D3 OPERATION OF A BEEF OXIDATION DITCH WITH AND WITHOUT SOLIDS REMOVAL

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R.O. Hagg, J.A. Moore and R.E. Larson
Transactions of the ASAE, V. 22, No. 2, p. 377-380, Mar.-Apr., 1979. 7 fig., 9 ref.

Keywords: Cattle wastes, Oxidation ditch, Waste treatment, Settled solids, Total solids, Kjeldahl nitrogen, Waste composition

A study was conducted to determine the effect of semicontinuous removal of settled solids on the operation of the batch-type oxidation ditch. The 90 ft. long, 15 ft. wide, 4.6 ft. deep oxidation ditch was located at the University of Minnesota Rosemount Experiment Station. It treated the wastes for two 18-steer confinement pens. A cable-operated scraper moved the settleable solids to the sump, from which the wastes were removed. Two types of aerating rotors were used—a brush-type rotor and a paddle-wheel-type rotor. It was found that 52% of the total solids entering the ditch were oxidized when settled solids were removed and 32-39% were oxidized without settled solids removal. Removing solids daily with a 22-mesh screen for 150 days accounted for 22 percent of the input solids. The remaining solids (52 percent) were oxidized in the oxidation ditch. Removing settled solids increased the time between oxidation ditch cleanings and decreased odors. Patterns of TS, COD, and Kjeldahl-N concentrations in the slurry were very similar in several experiments with a batch-operated, continuously fed oxidation ditch. The concentration of these parameters increased faster without solids removed than with solids removed. One disadvantage was that more equipment, time, and management were involved when solids removal was used. Increased treatment efficiency may not be sufficient to offset the added costs. It would be necessary to look to odor control or recycling the solids as feed to offset the added cost. (Merryman-East Central)

5611-A11, A12, B1, C2, C3, D1, D2, D3, E3 MANURE REFEEDING: REGULATIONS AND EQUIPMENT NEEDS

D.L. Day and J.M. Sweeten
Agricultural Engineering, V. 60, No. 5, p. 26-27, May, 1979. 3 fig.

Keywords: Recycling, Refeeding, Animal wastes, Legal aspects, Public health, Animal health, Biogas, Waste treatment

Manure may be used for fertilizer, feedstuff, and fuels. The economic feasibility of producing biogas from manure seems to be contingent upon sale of reclaimed feedstuffs from raw manure or from digested slurry. Because animal wastes can contain disease-producing organisms and parasites, residues of drugs and drug metabolites, and other contaminants of natural and industrial origin, the Food & Drug Administration has refused to sanction feeding of a number of animal wastes. The *Federal Register* for Dec. 27, 1977 carried an FDA request for additional data, information, and views on refeeding. In response to that request, Council for Agricultural Science and Technology provided a report prepared by a multi-disciplinary task force. The CAST report confirms the substantial nutritional values of animal wastes, particularly for cattle and sheep. Other CAST conclusions were: (1) Poultry manure has the highest nutritional value, cattle manure the lowest. (2) Nutrients from manure are used as efficiently as from other feed sources with equivalent nutrients. (3) The main safety concerns include the potential for transferring such residues as pesticides, drugs, minerals, toxins and other disease organisms. (4) Neither the quality of animal products nor their palatability are affected when waste is fed at nutritionally acceptable levels. Thus

while there is reason for continuing caution, problems haven't resulted from widespread feeding of animal waste in the past several years. Type of housing, the feeding system, and the collection system affect the feasibility of using manure as a feed ingredient. Manure's nutritional properties diminish with time. Some form of processing is necessary to obtain pathogen kill, reduce odors, preserve nutrients, and enhance palatability. Successful methods include drying (natural and heated air), ensiling, chemical treatment, and biological treatment. (Merryman-East Central)

5612-A3, A4, B2, C1, C2, C3, D3 FEEDLOT RUNOFF CONTROL WITH VEGETATIVE FILTERS

Department of Agricultural Engineering, University of Illinois, Urbana-Champaign, Illinois
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Proceedings of 1979 Livestock Waste Management Conference, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, March 6, 1979, p. A1-A11. 4 fig., 3 tab., 2 ref.

Keywords: Feedlot runoff, Vegetative filters, Overland-flow, Channelized-flow, Design, Water pollution control, Waste composition

Vegetative filters can provide a satisfactory, low-cost means of controlling feedlot runoff for many small and medium-size livestock feedlots. Such filters are not adaptable to every situation, however, and some management is required for satisfactory performance. Proposed design criteria have been developed for overland-flow and channelized-flow systems and are presented here. Channelized-flow systems appear to be less effective than overland-flow systems, requiring a much greater flow length for a similar degree of treatment. However, achieving uniform distribution and true overland flow is difficult. Further research is needed to verify our results for other conditions and to refine the proposed design criteria. The acceptance of the vegetative filter system by farmers appears to be much better than that for conventional treatment systems with holding ponds. Thus, the vegetative filter is likely to be adopted much more readily than conventional systems by operators of smaller feedlots, resulting in the reduction of pollution problems associated with feedlot runoff. The concept of a discharging vegetative filter system will have to be approved by pollution-control agencies before such systems can be recommended and used widely. (Vanderhoim-University of Illinois)

5613-A6, B1, D2, D3 EVALUATION OF COMMERCIAL PRODUCTS FOR ODOR CONTROL AND SOLIDS REDUCTION OF LIQUID SWINE MANURE

D.J. Warburton, J.N. Scarborough, D.L. Day, A.J. Muehling, S.E. Curtis and A.H. Jensen
Proceedings of 1979 Livestock Waste Management Conference, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, March 6, 1979. 1 tab.

Keywords: Odor control, Swine wastes, Liquid wastes, Liquefaction, Waste storage, Biological treatment, Chemical treatment, Manure pits, Deodorants, Masking agents, Adsorbents, Feed additives

An experiment was conducted at the University of Illinois to evaluate commercial odor control chemicals in terms of odor control efficiency and improved pumpability. These compounds fall into six categories: 1. Digestive - These products improve solids breakdown and contain bacterial cultures or enzymes to biologically control odor production. 2. Deodorants - These products contain chemicals which react with the odorants to inhibit their release as a gas or to neutralize their unpleasant odors. 3. Masking agents - Compounds with a strong, but acceptable smell overpower the unpleasant odors. 4. Adsorbents - Products like charcoal which have a large surface area may be used to adsorb the odorous chemicals before their release to the environment. 5. Feed Additives - Feed additives are marketed to improve animal performance and reduce manure odors. 6. Miscellaneous - This category includes chemicals whose action does not correspond to any of the other categories. Odor-panel evaluations of the chemicals were made. Overall performance of the odor-control compounds was disappointing. It was found that the masking agent was not effective because it was broken down by the bacteria. At higher dosage rates, the oxidizing agents might have been more effective, but the reaction rates for oxidizing ammonia and similar compounds was generally slow. Therefore, odorous gases might be released. Bacterial and enzyme compounds did not reduce odors. Aerobic treatment was the most effective method in this study. However, under anaerobic conditions, the reactions usually resulted in chemically reduced compounds, which were odorous. Chemical treatment for odor control was possible, but it was not the most economic alternative. The reduction of solids was also disappointing. (Little-East Central)

5614-B2, D3, E2 FLUSHING SYSTEMS FOR SWINE--PRINCIPLES AND PROBLEMS

Purdue University, Lafayette, Indiana
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Proceedings of 1979 Livestock Waste Management Conference, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, March 6, 1979, p. C1-C10. 5 fig., 4 tab.

Keywords: Flushing, Irrigation, Design, Swine wastes, Lagoons

There are two types of flushing systems used in swine production facilities: open-gutter flushing for finishing and gestation buildings and underlat flushing which can be used in any swine building. Both systems use a sloped, shallow gutter that is flushed periodically to remove waste from the building to a lagoon. The basic flushing system operates in the following way. A small-capacity pump transports lagoon water to a flush tank at the high end of the gutter in the building. The flush tank periodically dumps the water into the gutter. The spent flush water and waste reenters the lagoon, where it is treated and later reused for flushing. In areas where irrigation is practiced, many producers use fresh water for flushing instead of recycled

water. The flush water is then either irrigated directly on cropland or stored for later use. Flushing systems have the greatest appeal to those with farrow-to-finish operations who want to handle swine waste as a liquid and to those with suitable locations for lagoon construction. Advantages of gutter flushing include: lower initial cost, reduced odor problems, adaptability to building conversion and fuel savings. Disadvantages of gutter flushing include: greater nutrient losses, need for a relatively large land area, interruption of open-gutter units to give medication, mechanical problems, potential odor source and disease transmission. The design and operation of the basic parts of a flushing system are described in full. (Stiles-East Central)

5615-B2, B3, B4, E2 LAND APPLICATION OF ANIMAL MANURE -- HAUL OR PUMP?

Iowa State University, Ames, Iowa
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Proceedings of 1979 Livestock Waste Management Conference, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, March 6, 1979, p. D1-D7. 4 tab.

Keywords: Irrigation, Animal wastes, Waste storage, Land application, Nutrients, Equipment, Pumping, Hauling, Nitrogen

The various manure handling and storage systems available were investigated. Managers of livestock operations have different objectives for manure disposal, depending on their situations. The main objective was to provide the highest value between total returns minus total costs of disposal. Most solid manure is scraped and loaded with front-end loaders. For liquid-manure swine and poultry operations, the vacuum loading tanker is used, while the vertical-shaft submerged impeller pump plus a gravity-flow tank wagon is used for dairy and beef liquid-manure handling. Irrigation on nearby cropland is the most common means of land application. When comparing pumping systems with hauling systems, evaluation of the manure collection, treatment and storage used prior to disposal is required. The disposal site location, topography and soil types must also be considered. The advantages and disadvantages of handling slurry manures for surface spreading or subsurface injection and the use of irrigation equipment for land disposal were given. To eliminate soil nutrient overloading, waste nutrients from manure generated at animal production facilities must be adequately dispersed. Phosphorus and potassium are essentially conserved in slurry systems, while nitrogen values vary with length of storage, dilution level, climate and method of application. Scraper units are becoming more popular to rapidly remove wastes from buildings in order to control odor levels. Without the use of a lagoon, scraper units allow the same benefit of a better building environment through regular manure removal. The two main types of scraper units are center fold scrapers which fold over the chain on the return stroke and open at the start of the cleaning stroke and the tilting blade scrapers that are raised on the return cycle to travel back over the manure. In the final analysis, the livestock producer will have to select the system that best suits his needs. (Little-East Central)

5616-A2, A4, A6, B1, F2 CURRENT CONCERNS OF THE

IEPA AND EFFECTS ON THE PRODUCER OF THE RECENTLY ADOPTED ILLINOIS LIVESTOCK WASTE REGULATIONS

J.F. Frank
Proceedings of 1979 Livestock Waste Management Conference, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, March 6, 1979, p. E1-E15. 3 tab., 3 ref.

Keywords: Livestock wastes, Odor, Feedlot runoff, Water pollution, Legal aspects, Management

The Illinois Environmental Protection Agency (IEPA) requires a permit for any animal-feeding operation that meets certain criteria and is causing water pollution. When an IEPA employee visits a livestock facility, the operator is informed whether or not it is in compliance. If the facility is not in compliance, suggestions are given as to how the facility may be brought into compliance. The Draft Illinois 206 Water Quality Plan for Agriculture, currently undergoing public hearing, indicates that open feedlots producing feedlot runoff are the largest sources of water pollution from livestock waste in Illinois. Odors may also be a problem. Nuisance-odor conditions and complaints can be significantly reduced by the following: (1) Proper site location for new livestock facilities and residential areas. (2) Proper management techniques in the application of waste to land. (3) Use of new and emerging equipment technology. (4) Consideration for others living in your community by being a good neighbor. (Little-East Central)

5617-A6, B2, B3, D1, D3 CONTROL OF MANURE ODORS

Anonymous
Proceedings of 1979 Livestock Waste Management Conference, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, March 6, 1979, p. 501. 1 tab.

Keywords: Odor control, Management, Dehydration, Waste storage, Animal wastes, Anaerobic, Aerobic, Aeration

This study was conducted so that potential societal conflicts caused by odors might be minimized, and to assist engineers, land use planners, and animal owners on the location, planning, construction and operation of animal holding and production enterprises. The odors that are associated with animal enterprises are most frequently attributable to manure management. Feed storage, processing and distribution are other related potential odor sources. Objectionable odors existed when odorous compounds were emitted and transported to an area in which their presence was undesirable to people. Compounds released from decomposing manure which had been identified in the nearby atmosphere were listed. Odorous gases released during storage, treatment and handling of animal manures or manure slurries were mainly products of anaerobic microbial metabolism. Dehydration and disinfection can be used to inhibit anaerobic decomposition. Aeration to maintain dissolved oxygen could be used to replace anaerobic decomposition with the nearly odorless aerobic process. Masking agents, counteractants and deodo-

rants were designed to help in odor reduction. The following managerial procedures were given for odor control: (1) Locate a livestock operation at a reasonable distance from neighboring places. (2) Animal pens and feeding areas should be kept dry. (3) Manure management systems should be designed to prevent dirty-manure covered animals. (Little-East Central)

5618-A3, A4, B1, B4, F2 CURRENT ILLINOIS LIVESTOCK WASTE REGULATIONS

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nois

A.J. Muehling and D.H. Vanderholm
Proceedings of 1979 Livestock Waste Manage-
ment Conference, Department of Agricultural
Engineering, University of Illinois at Urbana-
Champaign, March 6, 1979, 4 p. 1 tab.

Keywords: Feedlot runoff, Water pollution,
Legal aspects, NPDES, Waste storage, Ani-
mal wastes

Current Illinois livestock waste regulations are given. The regulations apply to any feedlots where: (1) For a total of 45 days or more in any 12-month period, animals have been, are, or will be kept and fed. (2) Crops, vegetations, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility. In all open feedlots, surface water runoff must be controlled so that it will not cause water pollution. When storage is necessary, the storage facility must have adequate storage capacity. To adequately hold the runoff from storms, holding ponds and lagoons must be pumped down when conditions permit. Lagoons, tanks and holding ponds, must not leak. No body of surface water, except for small accumulations after a rainfall, are acceptable within the boundaries of a feedlot. The location of a new facility should be far enough away from populated areas to prevent objectionable odors. If located in a floodplain, any new facility must be protected against a flood of the size expected not more often than once every 10 years. New facilities must be located or built so that they will not cause a groundwater pollution hazard. Illinois Environmental Protection Agency will be increasing its field surveillance activities to determine whether facilities are complying with these regulations. Some livestock operations will be required to obtain an NPDES permit. This depends on the size of the animal-feeding operation and whether or not it has a discharge. (Little-East Central)

5619-B4, D1, D3, E2, E3 RECENT DEVELOPMENTS IN ANIMAL WASTE MANAGE- MENT SYSTEMS

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gan State University, East Lansing, Michigan
T.L. Loudon

Proceedings of 1979 Livestock Waste Manage-
ment Conference, Department of Agricultural
Engineering, University of Illinois at Urbana-
Champaign, March 6, 1979, p. F1-F19. 11 fig.,
4 tab., 5 ref.

Keywords: Waste storage, Flushing, Separation techniques, Waste management, Lagoons, Liquid wastes, Land application, Waste-water reuse, Dairy wastes

Selected recent developments in livestock waste handling and storage were discussed. Also methods of accomplishing collection and transfer and storage were reviewed to provide livestock producers with additional alternatives for improving waste handling. The major systems were: Free-stall alley flushing for dairy barns, liquid-solid separation systems, gravity transfer systems, pneumatic transfer systems, outside earthen basins and above-ground storage structures for liquid manure, and drained storage structures. In order to evaluate the potential of the systems for use in specific situations, the advantages, disadvantages and special management requirements for each were given. (Little-East Central)

5620-A8, B1, F2 ASSISTANCE AVAILABLE FOR PLANNING AND CONSTRUCT- ING ANIMAL WASTE MANAGE- MENT SYSTEMS

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Agriculture, University of Illinois at Urbana-
Champaign

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Proceedings of 1979 Livestock Waste Manage-
ment Conference, Department of Agricultural
Engineering, University of Illinois at Urbana-
Champaign, March 6, 1979, p. G1-G5.

Keywords: Sedimentation, Design, Loans,
Waste handling, Management

There is much valuable assistance available for farmers who need to build animal-waste-management systems. USDA and state agencies can provide expertise and financial help. Private enterprises may also provide these services and can assist the farmer with the actual construction. (Walker-University of Illinois)

5621-A11, B3, E3 EFFECTS OF BATTERY CAGE SHAPE AND DIETARY ENERGY REGULATION ON THE PERFOR- MANCE OF LAYING HENS OFFERED DIETS CONTAINING DRIED POULTRY MANURE

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D.J.W. Lee, W. Bolton and W.A. DeWier
British Poultry Science, V. 19, No. 5, p.
607-622, Sept., 1978. 9 tab., 16 ref.

Keywords: Poultry wastes-dried, Refeeding,
Poultry, Performance

(1) About 3000 medium-weight hybrid chicks were used in a factorial experiment involving two "chick" treatments: diets containing 0 and 50 g dried poultry manure (DPM)/kg; three "grower" treatments, diets with and without 50 g DPM/kg given *ad libitum* and regulated amounts of the diet with DPM: five

"layer" treatments: diet with 0, 100 or 200 g DPM/kg given *ad libitum* and regulated amounts of diets containing 110 and 220 g DPM/kg and two shapes of layer cages: deep (conventional) and shallow. (2) Chick diets had no significant effects on rearing or subsequent laying performance. (3) Food-regulated pullets were 7% lighter than pullets given the DPM diet *ad libitum* at 18 weeks but consumed 12.5% less food; growing treatments had no significant effect on subsequent egg production. (4) Hens housed in shallow cages laid 10.3 eggs/bird-housed more than those in deep cages, produced 3.8% greater egg mass, consumed 2.7% less food and produced fewer damaged (cracked, broken and hair-cracked) eggs ($P<0.001$). (5) DPM-containing layer diets had no adverse effects on egg production, or mortality; with 100 g DPM/kg efficiency of food conversion (EFC) was better than with 0 or 200 g/kg ($P<0.001$). (6) Reduction of the energy intake of L110R and L220R hens with diets containing 110 and 220 g DPM/kg by 8.2 and 9.0% respectively, reduced the number of eggs laid/hen-housed by 6 and 10.7 but improved the EFC ($P<0.001$); there was no significant interaction between cage shape and energy regulation. (Lee-Agricultural Research Council's Poultry Research Center)

5622-A8, B5, C1, C2, E2 FIELD MEASUREMENT OF DEN- ITRIFICATION: I. FLUX OF N_2 AND N_2O

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95616

D.E. Rolston, D.L. Hoffman, and D.W. Toy
Soil Science Society America Journal, V. 42,
No. 6, p. 883-889, 1978. 7 fig., 3 tab., 16 ref.

Keywords: Denitrification, Soils, Soil tempera-
ture, Nitrogen, Soil water, Fertilizers, Soil
gases, Irrigation, Land application

Absolute amounts and rates of denitrification from a Yolo loam (Typic Xerothents) field profile were studied in relation to the influence of soil-water content, organic C source, and soil temperature. Field plots were intensively instrumented with soil atmosphere samplers, tensiometers, and thermocouples. Soil-water contents were maintained constant with a spray irrigation system activated at frequent time intervals. The upper 15 cm of soil was maintained at soil-water pressure heads (h) of -15 and -70 cm of water for the two different water regimes of the experiment conducted at a soil temperature (5 cm depth) of 23°C. Soil-water pressure heads were maintained at -8 and -50 cm for the two water regimes conducted at 8°C. Plots cropped with ryegrass, uncropped plots, and plots to which manure was mixed in the top 10 cm of soil were used to establish three different C levels. Fertilizer was applied at the rate of 300 kg N ha⁻¹ as KNO₃ enriched with 20 and 40% ¹⁵N for the h = -15 or -8 and h = -70 or -50 cm treatments, respectively. The flux of gases at the soil surface was measured from the accumulation of N₂O and ¹⁵N₂ beneath an air-tight cover placed over the soil surface for 1 or 2 hours per day. Denitrification from gas fluxes occurred for the 23°C experiment in order of decreasing magnitude in manure (h = -15 cm), manure (h = -70 cm) cropped (h = -15 cm), cropped (h = -70 cm), uncropped (h = -15 cm), and uncropped (h = -70 cm) plots. Approximately 70% of the fertilizer N was denitrified for the manure (h =

-15 cm) treatment. Approximately 1% of the added fertilizer was denitrified in the uncropped ($h = -70$ cm) treatment. Denitrification from gas fluxes for the 8°C experiment occurred in the same order as that of the 23°C experiment except that rates and absolute magnitudes were much smaller. Approximately 11% of the fertilizer N was denitrified for the manure ($h = -8$ cm), and no measurable denitrification occurred in the uncropped ($h = -50$ cm) treatment. The amount of N_2 produced was much greater than N_2O for all plots. The N_2O flux at the soil surface was dependent upon time and degree of anoxic development and varied between 5 and 26% of total denitrification. (Roelston-University of California)

5623-A2, A4, B1, B2, F1 DESIGN AND COST OF FEEDLOT RUNOFF CONTROL FACILITIES

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J.R. Miner, R.B. Wensink and M. McDowell
Environmental Protection Agency Report
EPA-600/2-79-070, Mar., 1979, 133 p. 3 fig.,
30 tab., 10 ref.

Keywords: Computer models, Feedlot runoff,
Design, Waste storage, Economics, Water
pollution

Cattle feedlot runoff pollution control necessitates facilities to intercept and store surface runoff so manure-contaminated waters are prevented from entering streams and lakes. Design of these facilities requires a matching of individual structures to proposed management techniques and regional climatic data. Two computer models were developed for these purposes. The first, the sufficient design program, was a simulation model which sized feedlot runoff retention ponds based upon climatic data and management dewatering policies. In addition to minimum pond volume, the sufficient design model listed average number of yearly pumpings for each simulated management alternative at a selected pumping rate. The second model, an economic budget generator, determined cost of open feedlot runoff control systems. The models were tested at seven selected locations in the United States to determine effects of five pumping rates and seven management dewatering alternatives on minimum storage volumes required to prevent discharges as defined by EPA Effluent Guidelines. Stations selected represented a broad spectrum of climatic conditions. Lastly, effects of relaxing the discharge criterion were also studied at each location. (Miner-Oregon State University)

5624-B3, C1, C2, E3 TECHNICAL AND ECONOMIC EVALUATION OF TURKEY LITTER SILAGE AS A FEED SOURCE FOR REPLACEMENT DAIRY HEIFERS

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Technical Bulletin 1058, South Carolina
Agricultural Experiment Station, Clemson
University, Oct., 1978, 10 p. 4 tab., 14 ref.

Keywords: Poultry litter, Turkeys, Refeeding,
Cattle, Performance, Economics, Waste composition

Alternative levels of ensiled turkey litter were fed with corn silage and protein supplement to 24 dairy heifers. Results indicated that there was no statistically significant difference in the average daily gains of heifers fed rations containing 0, 15, 30, and 45 percent turkey litter silage. Least-cost rations were developed with alternative upper limits on the percentage of TLS in the ration. Feed costs per pound of gain decreased as the upper limit on TLS was increased. Total feed costs of growing a heifer from 450 to 1100 pounds were 125, 104, 92, and 83 dollars with TLS at upper limits of 0, 15, 30, and 45 percent of the ration, respectively. Feeding turkey litter silage to replacement dairy heifers could reduce feed costs for the dairy producer. Its use as a feed also may have important revenue implications for poultry producers, if the price of turkey manure is bid up to reflect its value to dairy producers as a feed. For example, if litter is used as a protein supplement and priced accordingly, profit per 20-pound bird would increase approximately \$1.44. (Thompson-Clemson University)

5625-B3, E3, F1 ECONOMIC ANALYSIS OF BROILER LITTER AS A FEED FOR STEERS

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C.S. Thompson and C.L. Cross
Bulletin 810, South Carolina Agricultural
Experiment Station, Clemson University,
April, 1978, 9 p. 3 tab., 7 ref.

Keywords: Poultry litter, Refeeding, Cattle,
Model studies, Computer models, Economics

Broiler litter waste is an economic alternative feed. Results of a feed performance study revealed that wastes can be substituted for other feeds. A production function was estimated and least-cost combinations calculated. On a dry matter basis, concentrate (corn) fixed at 30 percent of the ration was found to be: BLS, 46 percent; CS, 24 percent; and corn, 30 percent. Least-cost rations were also computed by using a least-cost linear programming model. Feed costs per kg of gain were estimated to be 55.8¢, 40.4¢, and 36.5¢ with an upper limit on BLS of 0, 10, 30, and 50 percent, respectively. Using litter as a feed allows a wider and more profitable use of a waste material. The value of litter produced in South Carolina, if used as a protein substitute, was estimated to be 3.5 million dollars. (Thompson-Clemson University)

5626-B1, C1, C2, D3 POULTRY MANURE TO PROTEIN FEED VIA FERMENTATION

Department of Animal Sciences, Colorado
State University, Fort Collins, Colorado 80523
B.F. Miller
Poultry Science, V. 54, p. 1795, 1975.

Keywords: Poultry waste, Fermentation,
Chemical treatment, Moisture content, Protein, Nitrogen

Fermentation of poultry manure has resulted in feeding material with ninety percent of the nitrogenous material as protein and only ten percent as non-protein nitrogen. Fermentation time has varied between two and nine days. The different energy supplements used were ground wheat, ground milo, acid whey and molasses with no energy supplement added as a positive control. Chemical treatments were tested to improve retention of ammonia in the manure mass. Various cultures of organisms were tested as a means to improve utilization and conversion of the nitrogenous material to proteins. The moisture content of the fresh manure was not reduced significantly by the fermentation process. Some treatments result in a pleasing aroma while other treatments produce materials with obnoxious odors and appearance. Protein content is influenced mostly by the nitrogen content of the fresh manure and the retention of this nitrogen by the treatment process. (Miller-Colorado State University) (Abstract only)

5627-B2, D2 PURIFICATION OF FISH CULTURE WASTEWATER BY FOAM FRACTIONATION

Consultant, 11128 Stillwater Avenue, Kensington, Maryland 20795
T.B. Lawson and F.W. Wheaton
Paper No. 78-5539, American Society of
Agricultural Engineers, 1978 Winter Meeting,
Chicago, Illinois, Dec. 18-20, 1978, 26 p. 9
fig., 2 tab., 12 ref.

Keywords: Fish farming, Wastewater treatment, Foam fractionation, Air injection

A venturi air injection system for mixing air and an aqueous solution of surfactant, Triton X-100, is used on a foam fractionation system. Surfactant extraction efficiency is determined as a function of four independent variables: (1) number of air holes in the venturi, (2) venturi throat cross-sectional area, (3) air hole cross-sectional area, and (4) solution flow rate. Similitude principles are used in modeling the venturi system and in development of prediction equations which relate the variables. (Lawson)

5628-B5, C2, E2 THE SIGNIFICANCE OF ANIMAL MANURE AS A SOURCE OF NITROGEN IN SOILS

Institute for Soil Fertility, Haren-Gr., The Netherlands
C.M.J. Sluijpmans and G.J. Kolenbrander
Proceedings of the International Seminar on
Soil Environment and Fertility Management
in Intensive Agriculture, Tokyo, Japan, 1977,
p. 403-411, 3 fig., 2 tab., 6 ref.

Keywords: Animal waste, Land application,
Nitrogen availability, Waste composition,
Crop response

The nitrogen in manure may be considered to be present in three fractions, differing in plant

availability: a readily available mineral fraction, an easily decomposable organic fraction which becomes available in the first year after application, and an organic fraction relatively resistant to microbial decomposition, becoming available in subsequent years. An attempt has been made to quantify each of these fractions chemically and express their availability in terms of equivalent amounts of fertilizer-N ("efficiency index"). Thus, size and efficiency of each of the fractions being known, the efficiency of the total N content of any manure can be calculated. Calculated first-year efficiency indices for different types of manure are in fair agreement with those from field experiments. Under Dutch climatic conditions, repeated equal spring applications of a certain manure will ultimately lead to a state of equilibrium in the soil, at which the annual nitrogen supply to the crop corresponds to about 75 kg fertilizer-N per 100 kg manure-N applied annually. The work reported shows promise for the possibility of calculating the efficiency of manure-N on a chemical basis, which would eliminate the need for costly experiments. (Slujsmans-institute for Soil Fertility)

5629-B1, C2, D1, D3, E3 MANAGEMENT OF SWINE MANURE FOR THE RECOVERY OF PROTEIN AND BIOGAS

Agricultural Experiment Station, Oregon State University, Corvallis, Oregon
L. Boersma, E. Gasper, J. Miner, J. Oldfield, H. Phinney and P. Cheeke
Management of Swine Manure for the Recovery of Protein and Biogas, Agricultural Experiment Station Report 507, Water Resources Research Institute, Oregon State University, May, 1978, 264 p.

Keywords: Swine wastes, Recycling, Protein, Biogas, Algae, Methane, Bacteria, Liquid wastes, Separation techniques, Feeds, Protein

Major findings of an investigation into the concept of nutrient and energy recovery from a swine waste management system are reported. Algae and bacteria were used to convert swine manure into methane-rich fuel gas and supplemental protein for animal feed. Waste heat from electricity generating plants was simulated to test its value in enhancing the biological recovery of nutrients and energy. The experimental facility was built adjacent to the Swine Research Center at Oregon State University and consisted of animal quarters with solid concrete floor and gutter to house 50 pigs, an anaerobic digester with a volume of 14 m³, and 12 outdoor algae basins with a combined surface area of 24 m² and a combined volume of 8,000 l. Manure was removed from the animal quarters by a gutter flushing system. The solids were separated from the liquids by gravity settling and then pumped into the digester for solubilization and recovery of biogas. The liquid phase of the diluted manure was pumped into the outdoor basins to serve as nutrient substrate for the growth of the high temperature strain 211/8K of *Chlorella vulgaris* as the predominant algal species. The algal biomass was concentrated by centrifugation and freeze dried. Its nutritional value as a protein source was determined by feeding trials with Long-Evans rats. (Boersma-Oregon State University)

5630-B1, C3 GROWTH OF FUNGI IN CATTLE DUNG

The University of Newcastle upon Tyne, Department of Plant Biology, Newcastle NE1 7RU, England
C.H. Dickinson and V.H.S. Underhay
Transactions of the British Mycological Society, V. 69, No. 3, p. 473-478, 1977. 2 fig., 2 tab., 7 ref.

Keywords: Fungi, Cattle wastes, Sporulation

Two different methods were used to study vegetative growth and sporulation in cow dung. The studies showed that various coprophilous fungi germinate and grow at different rates, that they use various substrates and that they may interact with each other in several ways. Growth and sporulation of coenocytic hyphae on the substrate was not as abundant as was expected according to other studies concerning fruit body development. The spread of hyphae in dung was adversely affected by water content. The differences between different types of dung and changes which occur during decomposition under a range of field conditions must be recognized in the future. (Little-East Central)

5631-B1, D3, E3 ANAEROBIC DIGESTER FOR STABLE MANURE

Anonymous
Compost Science, V. 20, No. 2, p. 10, March-April, 1979.

Keywords: Anaerobic digestion, Energy, Fertilizers, Horse wastes, Recycling

The manure- and urine-soaked bedding from the individual box stalls at Whinney Haw Stables of Pine Bush, New York is treated in an anaerobic system designed by Harry Buck. The system operates at 33 degrees centigrade and utilizes two 50,000-gallon digester tanks, one 50-gallon hot water heater and one 3,000 gallon mixing vat with a chopper pump. Besides fertilizer, the system yields energy to replace oil and gas. (Little-East Central)

5632-B2, C2, D3, D3, F1 ENERGY, PROTEIN FROM WASTES

Anonymous
New York's Food & Life Sciences, V. 12, No. 1, p. 23, 1979. 1 fig.

Keywords: Cattle wastes, Recycling, Methane, Soil conditioners, Economics, Poultry wastes, Substrates, Single-cell protein, Re-feeding

Researchers developed a unit to generate methane from cattle wastes. The unit consisted of a large trench covered with a rubber-like liner material that ballooned above ground as methane gas generated from the waste in the trench increased and filled the airtight cover. About 2,000 cubic feet of methane/day was produced. This translated into about \$1,000-\$1,500 worth of net energy a year. At prices of today, the digester would cost less than \$10,000 in equipment and materials. Another study converted poultry manure into a protein-rich feed. The waste was used as a medium for bacteria growth which resulted in a single-cell protein. The product contained as high as 40 percent true protein. The quality in terms of amino acids

compared favorably with conventional high-protein feedstuffs. The leftover wastes in both studies were relatively odorless and were suitable for use as soil conditioners. (Little-East Central)

5633-A6, B1 FIVE WAYS TO AVOID AN ODOR COMPLAINT

Anonymous
Hog Farm Management, V. 18, No. 5, p. 18, May, 1979.

Keywords: Odor, Management

Five tips for avoiding odor problems are given. (1) Consider odor a rural problem. The majority of complaints about swine odor are made by a long term rural resident against another long term rural resident. (2) Select the proper site. Locate the enterprise in the center of the property and build a road to it. The facility should not be closer than 1 mile to housing developments and should not be closer than one-quarter mile to neighboring residences. (3) Be a good neighbor. Complaints and nuisance odor conditions can be reduced by having consideration for others living in the community. (4) Push for good zoning. Zoning can be used to protect prime farmland. (5) Use good management. Producers should consider the nitrogen loss caused by spreading manure on top of the ground. Management changes in response to neighbor's complaints should be considered. (Little-East Central)

5634-A11, B3, E3 NUTRITIVE VALUE OF POULTRY MANURE IN DIETS FOR GROWING PULLETS AND LAYING HENS

Departamento de Avicultura, Instituto Nacional de Investigaciones Pecuaras, SAG, km 15.5 Carretera Mexico-Toluca, Palo Alto, DF B.S. Andree and A.G.M.S. Ernesto
Tecnica Pecuaria en Mexico, V. 30, p. 39-44, 1976. 6 tab., 14 ref.

Keywords: Refeeding, Poultry wastes-dried, Poultry, Performance

Three experiments were conducted to study the value of dried poultry manure (DPM) in pullets and laying hens of a commercial Leghorn strain. In experiment 1, DPM (11.83% true protein) was added at levels of 0, 5, 10 and 15% to pullet diets (8-22 weeks) in isoproteic sorghum + soya diets with 16% protein. Data obtained indicated no significant differences among treatments in feed consumption and age to first egg. Weight gain and feed efficiency decreased significantly with 18% DPM. In experiment 2 the addition of 0, 5, 10 and 15% DPM (11.83T true protein) in isoproteic sorghum + soya diets with 18% protein for laying hen was studied. Data obtained in 70 days of experimentation indicated no significant differences among treatments in egg production and feed efficiency. Feed consumption increased ($P < 0.05$) in the diets containing DPM. In experiment 3, 0, 10 and 20% of sorghum was replaced by DPM in sorghum + soya diets with 16.8% protein for laying hens. Data obtained in 105 days indicated significant differences

among treatments. Feed consumption increased linearly ($P < 0.05$) as the level of DPM increased in the diet. Egg production and feed efficiency decreased significantly with 20% DPM. There were no significant differences in egg weight among treatments. (Andree-Instituto Nacional de Investigaciones Pecuarias) (Article in Spanish)

5635-C1, D3 EFFECT OF ANTIBIOTICS AND CAPRYLOHYDROXAMIC ACID ON AMMONIA GAS FROM CHICKEN EXCRETA

Research Laboratories, Fujisawa Pharmaceutical Co., Ltd. Kashima 2-Chome, 1-6, Yodogawa-Ku, Osaka, Japan 532
K. Kital and A. Arakawa
British Poultry Science, V. 20, No. 1, p. 55-60, 1979. 3 tab., 11 ref.

Keywords: Poultry wastes, Thiopeptin, Ammonia, Caprylohydroxamic acid, Zinc bacitracin, Chemical treatment, Feed additives, Antibiotics

(1) Excreta from broiler chickens, when sterilized at 121°C for 20 min. released little ammonia gas after incubation at 33°C for 24 h. (2) Addition of thiopeptin to fresh excreta decreased ammonia production after incubation. Caprylohydroxamic acid did not have such an effect. (3) Dietary additions (100 mg/kg) of thiopeptin or zinc bacitracin resulted in decreased ammonia gas production from incubated fresh excreta. Similar addition of caprylohydroxamic acid did not decrease ammonia production. (4) Dietary supplements of thiopeptin (2-5 mg/kg) or zinc bacitracin (20 mg/kg) resulted in somewhat decreased ammonia production from incubated fresh excreta. (Kital-Research Laboratories, Fujisawa Pharmaceutical Co.)

5636-A4, A11, C2, C3, D1, E3 CATTLE PAUNCH CONTENTS AS FISH FEED SUPPLEMENT: FEASIBILITY STUDIES

Environmental Protection Agency, Robert S. Kerr Water Research Center, P.O. Box 1196, Ada, Oklahoma 74820
S.C. Yin and J.L. Witherow
Proceedings Third National Symposium On Food Processing Wastes, EPA-R2-72-018, New Orleans, Louisiana, Mar. 28-30, 1972, p. 401-408. 1 fig., 1 tab., 10 ref.

Keywords: Cattle wastes, Paunch manure, Dehydration, Refeeding, Fish farming, Biochemical oxygen demand

The seriousness of cattle paunch contents from abattoirs as a water pollutant was pointed out. As a remedy, it was suggested that the material be dried and used as a feed supplement in the rapidly growing commercial channel catfish farming industry. Air drying and BOD of fresh paunch were studied, as well as the frequency of occurrence of *Salmonellae* in the material. An EPA grant project (12080 HVQ) at Oklahoma State University will study the feasibility of using dried paunch as a feed supplement in both pond and cage cultures of channel catfish; the effects of the two methods of culture and the

possible deleterious effect of incorporating dried paunch in fish feed on water quality will also be determined. (S.C. Yin-Robert S. Kerr Water Research Center)

5637-A11, B1 A NEW REINFORCED CONCRETE SLAT SYSTEM FOR PIG HOUSING

Scottish Farm Buildings Investigation Unit, Aberdeen, Scotland AB2 9TR
S.H. Baxter and A.W.F. Anderson
Farm Building Progress, V. 46, No. 19, p. 19-24, Oct., 1976. 9 fig., 4 tab., 16 ref.

Keywords: Slatted floors, Swine wastes, Animal health, Design

A new system of reinforced concrete (rc) slatted flooring for use in pig housing is described. The evaluation of data, and the development of a triangular shaped slat is discussed and the casting technique using vertical, single or battery moulds is described. The slatted floor is complete with shaped end bases or beams resulting in a system of components which are easily, accurately and quickly manufactured, stored, transported and installed. (Baxter-Scottish Farm Buildings Investigation Unit)

5638-A11, B5, C2 FECES ANALYSIS PROVIDES CLUES TO ANIMAL DIETS

J.F. Blair
Feedstuffs, V. 51, No. 19, p. 36, May 7, 1979.

Keywords: Cattle wastes, Sheep wastes, Goat wastes, Deer wastes, Chemical analysis, Forages, Performance, Range management

Texas A&M University extension specialists are collecting and analyzing the feces of cattle, sheep, goats, and deer to determine the animals' diets and nutritional needs. Fecal analysis helps determine what forage species (which determines livestock performance on the range) are eaten. Some useful information has already been gained from tests being conducted on the Sawyer Ranch near Sonora, Texas. Livestock production at this ranch is limited by low phosphorous and crude protein levels in the range forages during the cold and dry weather. Analyses of forage samples showed a reduction in crude protein through 1977 and the cold winter of 1978. Suitable levels of crude protein did not appear until the spring rains in May and June of 1978 when phosphorous levels also became high enough to meet the needs of dry ewes and cows. By using both feed and fecal analyses, ranchers can more accurately determine what the animals eat and what they need in their diet. This helps determine the best feeding and range management practices, which will enable livestock to stay healthier and perform better. (Stille-East Central)

5639-A4, A6, A7, B1, C2, E2, F2 AVOIDING POLLUTION FROM LIVESTOCK WASTES

Agricultural Development and Advisory Service
Short Term Leaflet 185, Ministry of Agriculture, Fisheries and Food Agricultural Advisory Service, 1976, 14 p. 3 tab.

Keywords: Livestock wastes, Legal aspects, Water pollution, Trace elements, Land application, Odor control, Waste management, Air pollution

This leaflet gives guidelines for avoiding pollution from livestock wastes. Points relating to buildings are: (1) Careful consideration at the planning stage of a livestock enterprise should be given to waste management. (2) Clean water from roofs should be kept separate from stored manure unless specifically needed for dilution purposes. (3) Liquid draining from middens, livestock houses and collecting yards, and the wash-water from dairies should not be allowed to enter watercourses without the written consent of the Water Authority. These liquid wastes should usually be collected and applied to land. (4) Care should be taken when selecting a new site for livestock buildings to avoid odor nuisance. Prevailing wind direction is a major consideration. (5) Manure from housed livestock, if applied to land, should be applied at recognized acceptable rates. (Merryman-East Central)

5640-A11, B3, C1, C2, E3, F2 FEEDING POULTRY MANURE TO CATTLE

Animal and Dairy Science Department, University of Georgia, Athens, Georgia 30602
A.E. Cullison
Proceedings, 1976 Georgia Nutrition Conference, University of Georgia, p. 84-97. 2 tab., 27 ref.

Keywords: Refeeding, Poultry wastes, Cattle, Performance, Crude protein, Calcium, Phosphorus, Beef quality, Ash, Fiber

California, Colorado, Georgia, Iowa, Mississippi, and Oregon have authorized the sale and use of poultry manure for refeeding purposes. The experimental use of poultry manures as a cattle feed has been primarily as a component of rations for finishing steers. In most instances litter based broiler manures have been used. It has been found that cattle will consume feed mixtures containing poultry manure at levels up to 75% of the ration or even higher. Feed mixtures containing even low levels of poultry manure usually are consumed reluctantly for the first few days. Then they are consumed at levels of about 40% at or above normal levels of feed consumption. Cattle will consume feed mixtures containing over about 40-50% poultry manure only after a period of starvation and then usually at reduced levels. Beef quality is not adversely affected by such feeding. No harmful drugs or residues have been found in the organs or tissues of beef animals produced on poultry manure containing rations. No infectious diseases or digestive disturbances have been observed either. As a feed material, poultry manures are relatively high in crude protein, calcium, phosphorus and ash, and, if litter based, also fiber, but low in energy. About 20 to 30% poultry manure in a ground shelled corn based ration will usually meet these needs for steers. The great variation in the composition of poultry manures of the same type from different locations precludes the use of average composition figures for ration formulation purposes. Standard operating procedures which will result in manures of maximum nutritive value need to be developed for

poultry producers to follow if such products are to be used for feeding purposes. (Merryman-East Central)

5641-A11, B3, D3, E3, F1 RECYCLING CATTLE FEEDLOT MANURE TO BREEDING EWES

Animal Science Department, Utah State University, Logan, Utah
K.S. DeLeeuw and J.E. Butcher
Presented Utah Academy Arts, Sciences & Letters, October, 1975, 6 p. 3 fig., 4 tab., 6 ref.

Keywords: Recycling, Cattle wastes, Feedlot wastes, Diet, Economics, Waste management, Sheep, Waste composition

Cattle feedlot manure can be made palatable, at 45 to 75% of the total diet for feeding ewes. The energy from this manure is available to sheep and does not cause adverse effects in reproduction. However, the energy from this manure source is less than the energy that may be obtained from similar quantities of alfalfa. Preliminary economic analyses indicate that feeding manure-alfalfa mixes will be at least 1.6 times more costly than feeding alfalfa, using current prices. Variation in composition of beef manure is significant and therefore will be important in evaluating the potential use of beef manure as a sheep feed. In addition, sheep being fed manure are highly variable in acceptance of beef manure as a feed. Therefore, these sources of variability are of major importance in planning a feeding program with beef manure to be fed to mature breeding ewes. (DeLeeuw-Utah State University)

5642-D3, E3, F1 METHANE TO ELECTRICITY ON DAIRY FARMS: A MICRO-ANALYTICAL MODEL

S.L. Feldman and J. Breese
Compost Science, V. 20, No. 2, p. 6-7, March-April, 1979.

Keywords: Recycling, Methane, Economics

The economic efficiency of methane generation on a typical 65-cow dairy farm, juxtaposed against prices and costs of auxiliary energy supplied by rural electrification was studied. A four-module model was developed with which the following could be done: (1) assay peak and average annual demand for energy by the farm in peak and peak-off periods; (2) arrive at an approximation of the costs of electric utility generation to society; (3) estimate the costs of methane generation to the farmer; (4) relate the farmers' total costs to the utilities' total costs and revenues. The model based upon three different sets of conditions, described the interface between methane generation of electricity for farm and farm house use and electric utilities. From the cost analysis, the most efficient combination involved a 30-kw generator in which energy is sold to the utility. The electricity produced would be more expensive than presently priced electricity. With marginal cost pricing, the utility would lose to the extent of \$734 in the way of revenues and the farmer's deficit would total \$539. (Little-East Central)

5643-A11, B3, C1, D1, E3 ENSILED BROILER LITTER AND CORN FORAGE. II. DIGESTIBILITY NITROGEN UTILIZATION AND PALATABILITY BY SHEEP

Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
B.W. Harmon, J.P. Fontenot, and K.E. Webb, Jr.
Journal of Animal Science, V. 40, No. 1, p. 156-160, 1975. 4 tab., 18 ref.

Keywords: Ensilage, Poultry litter, Dry matter, Crude protein, Sheep, Nitrogen, Palatability, Digestibility, Dehydration, Performance

Studies were conducted to investigate the nutritive value and palatability of ensiled broiler litter and corn forage for ruminants. Corn forage, cut at two stages of maturity, was ensiled untreated, with .5% urea (wet basis), and with levels of litter to supply 15 and 30% of the total dry matter. All mixtures appeared to ensile properly. The silages were fed to sheep in two metabolisms and two palatability trials to study digestibility, nitrogen utilization and voluntary dry matter intake. The dry matter, crude protein and ash were higher for the ensiled mixtures containing broiler litter for both maturities. Dry matter digestibility averaged 84.5% and was similar for all silages. Apparent digestibility of crude protein was depressed by the later stage of maturity of the corn plant (57.1 vs 48.0% for control silages) and was increased by each level of litter addition. Nitrogen retention data indicated that litter nitrogen was well utilized; however, increasing the level of litter from 15 to 30% of the silage dry matter tended to depress efficiency of dietary nitrogen utilization. Voluntary dry matter intake was higher for silages containing broiler litter than for control and urea silages. Average daily dry matter consumption was 848 g for the control silages, 925 g for the urea treated silages, and 1,445 and 1,464 g for the silages containing 15 and 30% broiler litter, dry basis, respectively. (Harmon-Virginia Polytechnic Institute and State University)

5644-B1, B2, B3, B5, D1, E2 SPECIAL EQUIPMENT MOVES MANURE

M.F. Brugger
Hoard's Dairyman, V. 124, No. 9, p. 661, May 10, 1979. 2 fig.

Keywords: Animal wastes, Storage, Equipment, Irrigation, Land application, Animal waste handling

There is machinery available to empty stored manure and to get manure onto fields with minimal time and effort, depending on whether manure is solid, semisolid or liquid. The farm's layout and available tractors are important factors. The possible effects of soil compaction should be considered. Solid manure can be handled with conventional spreader and front-end loader when precipitation, which falls in the storage, is drained off. Temporary field storages may be advantageous if the fields are located at a distance away from farm buildings. Semisolid manure can be handled with a box-type or flail-type spreader and front-end loader. A self-loading tank which uses a loading unit attached to the rear for loading and unloading also is available.

Liquid manure must be agitated before it can be hauled to the field. Agitation breaks up any crust or scum mat and mixes together the liquids and solids which have separated. The stored manure can be agitated with special equipment which resembles a large outboard propeller screw or with the liquid manure agitation and loading pump. The time required to agitate manure storage depends on the type of agitation equipment, amount of water, solids and type of crust in the storage. Tank size should be based on volume of manure, ease of hauling to fields and size of tractor available to pull the tank. Liquid manure can be irrigated if the equipment is available. Manure must be worked into the soil within 4 to 6 hours after spreading if nutrient loss is to be minimized, regardless of the storage and handling method. (Little-East Central)

5645-A8, B5, E2, F2 MANURE APPLICATION RATES BASED ON TIME-RELEASE RESEARCH

Anonymous
Feedlot Management, V. 20, No. 4, p. 10, April, 1979. 2 tab.

Keywords: Application rates, Nitrogen, Denitrification, Livestock wastes, Poultry wastes, Feedlot wastes, Land application

A guide was published by soil scientists of the USDA which answered questions concerning manure application rates. This guide is based on the discovery that time-release rate, or decay constant, of available nitrogen is slower for manure that is low in nitrogen than for high-nitrogen manure. The guide also compensates for nitrogen that is lost from the soil due to volatilization of ammonia and denitrification. Denitrification is the process by which nitrogen is reduced to lower compounds with escape of nitrogen gas. Farmers should consider the guide when trying to improve the growth potential of cropland. Salt content and cost of application should also be considered. (Little-East Central)

5646-B2, D1 FEEDLOT RUNOFF CONTROL

O. Brandvold
Soil Conservation, V. 43, No. 11, p. 9-10, June 1978. 1 fig.

Keywords: Feedlot runoff, Runoff control, Livestock wastes, Design, Holding pond, Mounding

A simple but effective system was developed that prevented feedlot runoff from causing pollution in a nearby river. The Soil Conservation Service assisted in controlling the runoff. They designed a 1,100-foot-long settling channel that winds around a 3-acre feedlot and empties into a holding pond. Diversion ditches and dikes contain the feedlot runoff and keep clean runoff away from polluted areas. To improve drainage and provide dry areas for the livestock, mounds of earth were piled in the feedlot. Little solid waste reached the channel. (Little-East Central)

5647-B1, D3, F2 WASTE SYSTEMS ELIGIBLE FOR INVESTMENT CREDIT

Texas A&M University, College Station, Texas
R. Edwards
Hog Farm Management, V. 16, No. 15, p. 14, 16, May, 1979. 1 tab.

Keywords: Legal aspects, Pollution control, Facilities, Economics

The 1978 Revenue Act passed by Congress included a provision which changed the treatment of the investment credit when applied to pollution control facilities. The 1978 Act increased to 100% the amount of investment that qualifies for the credit where the special five-year amortization schedule is chosen. The new law indicated an increase in tax savings. There are limitations regarding the application of this provision. Some possible pollution control facilities eligible for certification under the 1978 Revenue Act are: (1) Runoff holding ponds, (2) Dewatering systems for runoff disposal, (3) Evaporation ponds, (4) Lagoons for manure treatment, (5) Lagoon aerators, (6) Manure storage pits - external vs. underfloor, (7) Hydraulic flush systems, (8) Liquid manure pumps, (9) Conveyance channels and pipelines, (10) Manure collection equipment, (11) Manure hauling/spreading equipment, (12) Dead animal incinerators, (13) Fly control sprayers, (14) Fences surrounding pollution control facilities, and (15) Buildings which house pollution control equipment. Appropriate state agencies or the district office of the U.S. Environmental Protection Agency should be contacted for proper certification procedures. (Little-East Central)

5648-A6, B2, D2

DEGRADATION OF TYROSINE IN ANAEROBICALLY STORED PIGGERY WASTES AND IN PIG FECES

Laboratory of Microbiology, Agricultural University, 6700 EJ Wageningen, The Netherlands
S.F. Spoelstra
Applied and Environmental Microbiology, V. 36, No. 5, p. 631-638, Nov., 1978. 4 fig., 5 tab., 19 ref.

Keywords: Swine wastes, Waste storage, Anaerobic, Odor, Tyrosine, Degradation, Gas chromatography

Radioactively labeled compounds that might be intermediates in the anaerobic degradation of tyrosine were added to pig feces and to stored piggery wastes. Changes in the compounds were followed by using thin-layer and gas chromatography. In feces, p-cresol and 3-phenylpropionic acid were the end products of tyrosine metabolism; in anaerobically stored mixed wastes, phenol, p-cresol, and minor quantities of phenylpropionic acid were formed. Schemes were proposed for the degradation of tyrosine in pig feces and in mixed wastes. (Spoelstra-Agricultural University)

5649-A10, A11, 5, C3

PARASITISM AND PRODUCTION IN WEANER SHEEP GRAZING ALTERNATELY WITH CATTLE

Division of Animal Health, CSIRO, Armidale, New South Wales, Australia
I.A. Barger and W.H. Southcott
Australian Journal of Experimental Agriculture and Animal Husbandry, V. 18, p. 340-346, 1978. 2 fig., 5 tab., 5 ref.

Keywords: Sheep, Cattle, Grazing, Parasites, Performance, Anthelmintics

Three systems for the post-weaning management of Merino wethers were compared over two years. In all systems, the sheep were given two anthelmintic treatments with levamisole per year; at weaning in January, and in July. In the first system (SC) the same paddock was used as a weaning paddock each year in succession. In the second system (SC 6) sheep and cattle grazed the paddock alternately for 6-month periods from January and July; the third system (SC 12) comprised sheep and cattle grazing alternately for 12-month periods from July of each year. Compared with the SC treatment, weaners from the SC 6 treatment had significantly lower faecal egg counts and lower burdens of *Haemonchus contortus*, *Trichostrongylus axei*, *Trichostrongylus colubriformis* and *Nematodirus* spp. They had significantly higher numbers of *Cooperia oncophora* and similar numbers of *Ostertagia circumcincta*. SC 6 sheep made greater liveweight gains, produced heavier fleeces and suffered lower mortalities than their SC counterparts. Results for the SC 12 system were usually intermediate. In a third year, the SC 12 system was modified to include a monthly treatment with levamisole. The liveweight gains, egg counts and mortalities of the monthly treatment sheep did not differ significantly from those of the SC 6 sheep. Both systems were superior to the SC treatment in controlling nematode infections in weaner sheep. There were no significant effects of any treatment on liveweight gains of cattle, although outbreaks of ostertagiosis occurred in the third year in two of the four replicates of the SC system. (Barger-CSIRO)

5650-B1, F1

WHAT HOUSING FOR SUCKLER COWS?

Scottish Farm Buildings Investigation Unit
J.A.D. MacCormack
Farm Building Progress, V. 53, p. 3-6, July, 1978. 6 fig., 13 ref.

Keywords: Waste management, Housing, Suckler cows, Slurries, Design, Economics

The advantages and disadvantages of systems used to house suckler cows were given: (1) Roofless slatted courts were the cheapest alternative considered and the health of the cattle was very good under this system. However, the system was unpleasant for stockmen in bad weather. When it rained, the animals stayed dirty, the feed got wet, causing spoilage, and it diluted the slurry. (2) Cubicles with bedded calf creep was a simple slurry system that had a do-it-yourself potential, and offered economies in straw bedding for calves. This system was quite expensive, required regular scraping and muck was handled in two forms. (3) Slatted courts with bedded creep provided straw bed for calves and had a slurry system for most of the waste. However, wastes were handled in two forms. Straw could get into the slurry, and there was the possibility of poor access to the creep. (4) Fully slatted courts handled all the wastes as slurry, had good supervision of stock and the building was flexible for other uses. (5) Fully bedded courts were more

comfortable for the stock, the stock were kept cleaner and the building could be used for different purposes. However, there was a high straw requirement, and much labor was involved for bedding and mucking. The individual farm, farmer or stockmen must determine the right system for their own particular needs. (Little-East Central)

5651-A8, B2

THE EFFECT OF CATTLE SLURRY AND INORGANIC NITROGEN FERTILIZER ON THE YIELD AND QUALITY OF SPRING BARLEY

National Institute for Research in Dairying, Shinfield, Reading, Berkshire, England
B.F. Pain, S.J. Richardson and R.J. Fulford
Journal of Agricultural Science, V. 90, p. 263-269, 1978. 8 tab., 8 ref.

Keywords: Slurries, Cattle wastes, Land application, Crop response, Fertilizers, Ammonium nitrate, Nitrogen

In experiments over 3 years (1974-6) cow slurry in the range 0-112.5 t/ha and ammonium nitrate in the range 0-120 kg N/ha were applied to field plots factorially to test the effects on the yield and quality of spring barley grain. In 1974, slurry application markedly improved the grain yield (cv. Golden Promise) at each rate of inorganic N and increased grain size. Applying N fertilizer with more than 37.5 t slurry/ha reduced grain yield below the maximum. Grain with the highest crude protein content (15.1%) was obtained from a combination of slurry and inorganic N. The residual effects of the slurry treatments gave satisfactory grain yields in 1975 without additional fertilizer. Grain yields (cvs Julia and Abacus) in other experiments carried out on a different soil type in 1975 and 1976 were approximately half those obtained in 1974, due in part to drought conditions. The pattern of the results was similar. Heaviest grain yields were harvested from plots receiving 70 t slurry/ha with no additional N. (Pain-National Institute for Research in Dairying) (Cambridge University Press)

5652-B2, B4, E2, F1

SELECTING DAIRY MANURE HANDLING SYSTEMS

Midwest Plan Service
AED-18, 1978.

Keywords: Dairy wastes, Waste management, Waste storage, Land application, Economics

Before selecting a manure handling system, two decisions must be made: (1) Will you haul manure daily or store it before spreading? (2) Will you handle manure as solids or liquids? Once these decisions are made, collection, storage, and hauling units may be chosen to fit individual needs. Advantages and disadvantages of (1) daily hauling and spreading and (2) storing and spreading are listed. Descriptions of storage facilities for solid and liquid wastes are given. Factors which should be used in deciding where to locate storage are cited. A manure analysis gives the best estimate of manure nutrient content. Immed-

late incorporation of the manure into the soil will save much of the nutrients and will prevent loss by runoff. Tables give the relative cost estimates for the principal cost factors so different manure handling systems can be compared. (Merryman-East Central)

5653-A6, B2, B3, C1, C2, D1, D3, E2, E3

THE EFFICIENT USE OF SLURRY

L.E. Osborne
Agricultural Engineer, V. 30, p. 40-43, 1975. 4 fig., 10 ref.

Keywords: Animal wastes, Slurries, Waste treatment, Land application, Odor, Management, Waste disposal, Separation, Aeration, Recycling

The various methods of dealing with slurry to optimise the best use of the plant nutrients contained were studied. It was found that land spreading is the cheapest form of slurry disposal. Factors to be considered in land spreading are: dilution and contamination, spreading on sloping or unsaturated land and unstable soil, spreading out of the growing season, spreading odorous slurry wherever odor nuisance can arise, and spreading at rates so high that a solid mat accumulates on the surface. For the dairy unit, separation of solid and liquid fractions of slurry can prove to be a valuable aid to management. When using a separator, the results are a stackable, easily handled solid and a liquid which, does not crust upon settling. The advantages of separation are greater for cattle slurry than for pig slurry. It was found that the liquid separation will smell when removed from storage. Aeration before its removal will reduce these odors. Sub-surface injection, which can eliminate odor problems when applying slurry to land, has been investigated in the United States and Europe. The advantages are: runoff is eliminated, plant nutrients are placed in the soil and damage to the soil structure by surface matting or ponding at high application rates is avoided. The power requirement is high and the use of separated slurry or the provision of an effective stirrer and chopper on the machine is essential if blockages are to be avoided. Pilot scale experiments have shown that up to 70% of the slurry produced daily by 400 pigs can convert into solids by a treatment system consisting of separation, high rate filtration and sludge de-watering. The solid products are odor free, can be stacked and spread when needed or sold to gardeners or horticulturalists. The liquid is low in suspended solids, is easily pumped and stored, and can be applied to land at much higher rates than raw slurry. During the last year with shortages in the world energy situation, the emphasis on slurry handling is changing from disposal to recycling to the land. The results of farm trials now in progress will provide firm guidelines, improved techniques, and solutions to the management problems occurring where conventional land-spreading systems are used. (Little-East Central)

5654-D3

IT'S A GAS

J. Ross
Canadian Farming, p. 19-21, Spring, 1978. 3 fig.

Keywords: Bioconversion, Energy, Methane, Digesters, Anaerobic, Gases

In 1973, a pilot project was established at the Glenlea Experimental farm, south of Winnipeg, Canada. The study was performed to see if a digester could produce enough methane gas in a cold climate to make it worthwhile as an energy source. The researchers were worried that it would take so much of the gas produced to keep the process going that the energy gain would be too small to be useful. After five years of experiments, it was found that a biogas digester can be used as an energy source in a cold climate. (Little-East Central)

5655-A11, D3, E3

RECYCLED POULTRY LITTER... NOW IT'S FATTENING BEEF CATTLE

Department of Poultry Science, Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas
C.R. Creger, F.W. Gardner, and F.M. Farr
Texas Agricultural Progress, V. 19, No. 3, p. 2-3, 1973. 4 tab.

Keywords: Poultry wastes, Recycling, Silage, Performance, Animal health, Fermentation

The Texas A&M University System is studying the problems of animal waste disposal. One such method being used is that of recycling poultry litter to beef cattle as a silage feed. The silage was made from 100 percent broiler litter for cattle rations. Pine shavings were used as a source of litter for the broiler chicks used in the study. Drugs were fed to the broilers during this time. Water was added to the broiler litter until the total moisture content was 35 to 38 percent. About 40 tons of this material was packed well into an airtight, upright silo for 6 weeks. Calves were then placed on a feeding regimen that consisted of broiler litter silage free choice and 12 percent protein mix. These calves gained an average of 2.54 pounds per day. The amino acid content showed the silage to be a good source of protein. The drugs were either destroyed during the fermentation process or were not absorbed by the animals in any appreciable amounts. The organoleptic comparison of the test steaks and control steaks noted only small flavor differences. (Little-East Central)

5656-B1, B2, B3, C1, C2, D1, D3, E2

ESTIMATING QUANTITY AND CONSTITUENTS IN LIVESTOCK AND POULTRY MANURE RESI- DU AS REFLECTED BY MAN- AGEMENT SYSTEMS

USDA-SEA-AR, Lincoln, Nebraska
C.B. Gilbertson, D.L. Van Dyne, C.J. Clanton, and R.K. White
Transactions of the ASAE, V. 22, No. 3, p. 602-611, May-June, 1979. 2 fig., 15 tab., 6 ref.

Keywords: Livestock wastes, Poultry wastes, Computer model, Animal wastes, Waste management

"Best usable values" for livestock and poultry manure residue were calculated by use of a

computer model. The values reflect gains, losses, and transfers of solids and nutrients that result from alternative manure management systems. (Gilbertson-SEA-AR)

5657-A7, A11, B1, C1, C2, C3

EFFECT OF AIR CONTAMI- NANTS ON PERFORMANCE AND QUALITY OF BROILERS

Department of Animal Sciences, Colorado State University, Fort Collins, Colorado 80523
C.L. Quarles and D.D. Caveny
Poultry Science, V. 56, No. 3, p. 543-548, May, 1979. 1 fig., 8 tab., 28 ref.

Keywords: Air pollution, Dusts, Ammonia, Bacteria, Performance, Poultry, Animal health

Air contaminants such as dust, NH_3 , and bacteria are causing great economical loss and must be minimized in the breeder flock, hatchery, and broiler house. Hatchery studies indicated bacterial contamination of eggs and subsequently chicks were associated with early mortality. Types of houses for breeders were associated with poultry dust and bacterial contamination of eggs. Filtered air in the hatchery reduced bacteria and early death loss in chicks. Chick studies linked management practices with NH_3 , dust, and disease incidence within flocks. The interrelationship of mitigating influences should be recognized and influence management practices to obtain maximum performance and quality. (Quarles-Colorado State University)

5658-B1, C1, E2, F1

EFFICIENT MANURE HAND- LING CAN HOLD DOWN FEEDLOT COSTS

J. Sinise
Calf News, V. 17, No. 5, p. 14, 46, May, 1979. 2 fig.

Keywords: Cattle wastes, Feedlots, Economics, Equipment, Collection, Land application, Waste management

Manure handling costs make up about 12 percent of the total feedlot operating expense for 20,000-head, dirt surfaced feedlots, according to John Sweeten of Texas A&M University. In order for manure handling to be profitable, time, energy and equipment costs must be controlled. Three functions are involved in the management of feedlot manure: collection, loading, and spreading. Beef cattle on high concentrate rations excrete approximately two tons of manure (at 40% moisture) per animal per year that must be harvested from the feedlot surface. Operating costs per animal-day are usually lower for large feedlots than for smaller ones and costs increase with haul distance. Sweeten compared three collection systems for operating efficiency, productivity, energy efficiency and cost of collection. The operating efficiencies ranged from 79 percent for the loader to 90 percent for the elevating scraper. The wheel-loader chisel-plow combination gave the highest collection rates. Wheel loaders without prior chisel plowing gave a 33 percent lower collection rate and consumed 30 percent more energy than the loader/chisel plow combination. The elevating scraper system

was 9 to 46 percent more energy efficient than the wheel loader systems. Estimated cost of collection was 18 cents per ton for the wheel loader preceded by rototilling. The wheel loader with no surface preparation gave a cost of 21 cents per ton. Cost of collection with the elevating scraper was 19 cents per ton. The average costs for loading a manure spreader truck was 11 cents per ton when the operator's performance was adjusted to 100 percent efficiency. Charges paid by farmers to feedyards and contractors for manure hauling and spreading on cropland ranged from \$1.25 to \$2.60 per ton plus seven to 10 cents per ton-mile. (Little-East Central)

5659-D3, E3

INHIBITION OF METHANE PRODUCTION BY METHANOBACTERIUM FORMICUM

Rowett Research Institute, Bucksburn, Aberdeen, Scotland
P.N. Hobson and B.G. Shaw
Water Research, V. 10, p. 849-852, 1976. 4 fig., 10 ref.

Keywords: Swine wastes, Digesters, Methane, Fatty acids, Ammonia, Copper, Anaerobic

Cultures of *Methanobacterium formicum* were used for inhibition studies to determine the effects of volatile fatty acids, ammonia and copper on methane production from swine wastes. Acetate and butyrate (volatile fatty acids) did not inhibit *Methanobacterium formicum*. Propionate (a fatty acid) and ammonia were inhibitory to *Methanobacterium formicum* above certain concentrations. Total copper concentrations in excess of 200 mg l⁻¹ must be present before severe inhibition occurs. Inhibitory concentrations of copper were difficult to define as varying amounts may be precipitated as the sulphide. No effects attributable to copper have so far been found in digesters loaded with waste of up to about 7% total solids. (Little-East Central)

5660-A8, D1, E2

HIGHER UPTAKE OF SUPERPHOSPHATE BY MIXING WITH FARMYARD MANURE. PART I: HIGHER UPTAKE OF SUPERPHOSPHATE BY PLANTS

Nuclear Institute for Agricultural & Biology, Lyallpur, Pakistan
M. Sharif
CENTO Seminar on Fertilizer Analysis Methods, Sampling Quality Control, 1974, p. 268-274. 3 tab., 19 ref.

Keywords: Animal wastes, Superphosphates, Mixing, Phosphorus, Fertilizer, Land spreading, Crop response

The effect of premixing at various rates of superphosphate (SUP) with farmyard manure (FYM) on the uptake of fertilizer phosphorus by maize plants was studied. The results were tested on fields of cotton and wheat crops. It was shown that premixing SUP with FYM appreciably increased the availability of fertilizer phosphorus to plants from alkaline calcareous soils of Pakistan. Premixing SUP

with FYM may make SUP more effective due to close association of the two fertilizers attained during premixing. Application of this mixture to soil was expected to keep organic matter concentrated around the SUP particles. Premixing increased the availability of SUP much more from lower doses of SUP than from higher doses. Another advantage of premixing technique is that it increases the availability of SUP to plants more at later stages of plant growth than at earlier stages. The mixing technique would be highly useful in phosphorus nutrition of plants, since plants mainly suffer from phosphorus deficiency during the later stages such as during the flowering stage of plant growth. (Little-East Central)

5661-B1, B2, D3, F1

SLURRY LAGOON WITH GRAVITY EMPTYING

J.A.D. MacCormack
Farm Building Progress, No. 37, p. 15-18, July, 1974. 3 fig.

Keywords: Storage, Slurries, Lagoons, Agitation, Economics

A lagoon was built by Mr. A. Kerr of Bourtribush, Ayrshire Scotland which proved to be an economical method of storing slurry, and with the method of emptying adopted, it was foolproof in operation. The lagoon is approximately 70 x 50 ft and slurry from Mr. Kerr's 140 cow cubicle unit is stored to a depth of 4 ft. The holding capacity is 90,000 gallons or about a three-month supply. The slurry was scraped from the cubicle building directly into the lagoon through low-level openings in the wall, each provided with a flap to exclude draughts. The outlet is at the opposite side of the lagoon. A screw-operated sluice gate opens onto an excavated drive-through pass in which a spreader receives the slurry. Before emptying the lagoon, it was necessary to agitate the slurry to prevent the more liquid material from draining from beneath the crust. When the level of slurry drops to about 300-mm (1-ft) depth, the railway sleeper wall section can be removed and the tractor can be driven over low ramps into the lagoon which has a concrete floor. The remaining slurry was agitated by the tractor and moved towards the outlet for complete emptying. (Little-East Central)

5662-B1, C1, C3, D1, D3, E3

THE TREATMENT OF ANIMAL WASTES

Scottish Farm Buildings Investigation Unit
A.M. Robertson
Farm Building Progress, V. 32, p. 13-17, April, 1975. 11 fig., 3 ref.

Keywords: Animal wastes, Waste management, Aerobic, Digester, Aeration, Waste storage, Anaerobic, Design, Lagoon, Degradation, Waste treatment

The object of this study was to develop systems of waste handling which will be compatible with the present and future structure of agricultural production. System 1, a two-stage aerobic system, was constructed with two below-house oxidation ditches. The problems occurring with this system were excessive and persistent foaming, the accumu-

lation of solids and, at times, a deficit of oxygen. In order to improve the degree of treatment, a second stage of aeration using the inner channel of the house was incorporated and a sloping-bottomed settling tank was installed in the central channel of the house. Under normal operating conditions in the primary channel, an extract of 5% could be removed at 7-9 kg/min which when put on a drying bed gave a material of 15% DM. System 2 was based on single stage aerobic treatment. Aeration was performed in a cylindrical vessel with a centrally mounted surface aerator driven by a 1.5 kW (whp) geared motor. In order to maintain a dissolved oxygen level of approximately 20% of saturation, it was only necessary to operate the system intermittently. At present, aeration takes place 16 h/day. This mode of operation was useful in maintaining alkaline conditions in the vessel. System 3, an anaerobic lagoon, (19.5 x 7.31 x 2.1 m deep) with a butyl rubber lining was constructed giving a capacity of 3.3 m³/70-kg pig. The lagoon was loaded daily with waste from a growing-finishing house; supernatant liquor was removed from the lagoon and was treated in an oxidation channel. Visual examination of the lagoon indicated that solids breakdown was occurring with an accumulation of approximately 100 mm of solid material after two years loading. The solids level in the oxidation channel had not yet reached 1% after nine months of operation. System 4, a fully-enclosed heated digester, is now under construction. This design is based on a 100 litre prototype which has been operated at the Rowett Research Institute. The proposed system includes facilities for gas storage and heating of the digester vessel using gas produced by the anaerobic degradation of waste. (Little-East Central)

5663-A4, A6, B2, B4, D3, E2

THE HANDLING OF ANIMAL WASTES

National Institute of Agricultural Engineering, Silsoe, Bedford, England
J.C. Hawkins
Veterinary Record, V. 102, p. 182-185, Feb. 25, 1978. 5 fig., 9 ref.

Keywords: Livestock wastes, Waste treatment, Slurries, Waste storage, Odor, Feedlots, Land application, Separation techniques, Water pollution, Aeration

The problems of farm animal waste treatment is addressed. Slurry should be used on land as a source of plant nutrients. As this can only be done at certain times of the year, slurry has to be stored. Storage gives rise to problems of mixing, handling, application, pollution, odor, and pathogen survival. These can be solved by special machinery to separate slurry into solid and liquid fractions. The NIAE has developed a system for slurry treatment for intensive pig units on limited land close to houses, which can convert all the slurry from a fattening piggery into inoffensive solids. (Solid Waste Information Retrieval System)

5664-A8, C2, E2

VALUE OF MANURE AND SEWAGE SLUDGE AS N FERTILIZER

F. Pomares-Garcia and P.F. Pratt
Agronomy Journal, V. 70, p. 1085-1089, 1978.
4 fig., 3 tab., 19 ref.

Keywords: Feedlot wastes, Sewage, Sludge, Nitrogen, Barley, Organic compounds, Forages, Mineralization

In a greenhouse pot experiment with a manure having 1.5% N and sewage sludge having 4.2% N, the available N was estimated from the amount required to equal $(\text{NH}_4)_2\text{SO}_4$ -N in terms of barley forage production. Feedlot manure was applied at rates of 0, 20, 40, and 60 metric tons/ha and sewage sludge at rates of 0, 10, 20, and 30 metric tons/ha combined factorially with 0, 50, 100, 150, and 200 mg N/kg of soil as $(\text{NH}_4)_2\text{SO}_4$. Barley and sudangrass were used as test crops. Barley yields were increased by additions of organic materials and $(\text{NH}_4)_2\text{SO}_4$. Both manure and sludge addition decreased the response to $(\text{NH}_4)_2\text{SO}_4$. In 10 months, only 17.2 and 40.9% of the N in manure and sludge, respectively, had mineralized. The total N associated with a 10% reduction in relative yield of barley forage was estimated as 2%. The estimated critical NO_3^- -N content in barley forage was 0.12% which was lower than the accepted safe level of NO_3^- in forage for livestock. (Little-East Central)

5665-A11, C1, C2, D1, D2, E3, F1 RE-CYCLING ANIMAL WASTE AS FEED: A REVIEW

Punjab Agricultural University, Ludhiana
141004

J.S. Ichhponani and G.N. Lodhi
Indian Journal of Animal Science, V. 48, p.
234-243, May, 1978. 14 tab., 32 ref.

Keywords: Animal wastes, Substrates, Recycling, Refeeding, Single-cell protein, Waste composition, Nitrogen, Dehydration, Performance, Economics

The nutritional worth of the various types of animal wastes for livestock feeding was studied. The potential of these wastes, as well as cellulosic wastes, as substrates for the production of single-cell protein (SCP) and wastage were mentioned. It was found that animal wastes have the potentiality to supply protein, energy, and other nutrients for livestock feeding. The animal wastes could supply energy equivalent to 4.3 million tonnes of cereals or protein equivalent to 4.2 million tonnes of oilseed-cakes. Animal wastes could be used as substrates for production of single cell protein suitable for human food or livestock and poultry feed. The ensiling process was also an efficient means of using poultry and cattle manure as feed for cattle. In order to realize animal wastes as animal feed, it is necessary to develop suitable and cheap processing technology. (Little-East Central)

5666-A6, B1, B2, F2 THE STINK OVER ODOR REGU- LATIONS

V. Sanderson
Des Moines Sunday Register, Sept. 26, 1978.

Keywords: Legal Aspects, Odor, Manage-
ment

There was a stink being raised over proposed odor regulations under consideration by Iowa's Department of Environmental Quality (DEQ). The DEQ proposed a permit system without drawing up any criteria for farmers and industries to follow. Most of the odor problems boiled down to management. It was impossible to have a hog operation with a lagoon without having odor problems. Many agricultural organizations were disturbed about the length of time established for the "offended party to be offended by the odor." The proposed regulations said the odor must occur in a frequency of three or more days per 30-day period for a total of three or more hours in each day. The organizations felt the time limitation should be extended. The air quality board was to take the proposed regulations under consideration. (Little-East Central)

5667-A11, B1, C2 ISOLATION AND CHARACTERI- ZATION OF MULTIPLY ANTI- BIOTIC-RESISTANT CLOSTRIDI- UM PERFRINGENS FROM PORCINE FECES

Food Research Institute, University of Wis-
consin, Madison, Wisconsin, 53706
J.I. Rood, E.A. Maher, E.B. Somers, E.
Campes, and C.L. Duncan
Antimicrobial Agents and Chemotherapy, V.
13, No. 5, p. 871-880, May, 1978. 3 fig., 2 tab.,
39 ref.

Keywords: Antibiotic resistance, *Clostridium*
perfringens, Swine wastes, Feed additives,
Antibiotics

Multiply antibiotic-resistant strains of *Clostridium perfringens* were isolated from porcine feces. Strains that were resistant to tetracycline, erythromycin, clindamycin, and lincomycin were isolated, but no penicillin- or chloramphenicol-resistant strains were obtained. Typical minimal inhibitory concentrations for resistant strains were 16 to 64 μg of tetracycline per ml, 64 to 128 μg of erythromycin per ml, $\geq 128 \mu\text{g}$ of lincomycin per ml, and 16 to 128 μg of clindamycin per ml. Resistance to erythromycin was always associated with resistance to lincomycin and clindamycin. Minimal inhibitory concentrations were determined for 258 strains from six farms that used antibiotics in their feeds and 240 strains from five farms that did not use antibiotics. The results show that 77.9 and 22.7% of the strains from the former farms were resistant to tetracycline and erythromycin-clindamycin-lincomycin, respectively. The comparable data from the latter farms were 25.0 and 0.8% respectively. Agarose gel electrophoresis failed to reveal a plasmid band that was common to the resistant strains but absent in the susceptible strains. Attempts to transfer tetracycline, erythromycin, and clindamycin resistance from one strain, CW459, were not successful. Antibiotic-susceptible mutants were not isolated from this strain, despite the use of a variety of curing agents. (Rood-University of Wisconsin)

5668-C3, D3, E3, E4, F1 MANURE-TO-METHANE PLANT NEARS STARTUP

Anonymous
Chemical and Engineering News, V. 56, No.
50, p. 6, 7, Dec. 11, 1978.

Keywords: Animal wastes, Anaerobic, Dige-
stion, Methane, Refeeding, Economics

The largest experimental anaerobic digestion plant to convert animal wastes into methane will be in production by February, 1979 in Bartow, Florida. It will process 25 tons per day (on a dry basis) of manure from cattle feedlots, converting it into a gaseous mixture of about 80% methane and 40% carbon dioxide. The gas will be sent through a short pipeline to an adjacent packing plant where it will be used to heat steam boilers. Solid residue from the conversion process will be separated from liquid wastes and re-fed to cattle as a protein supplement. The Experimental Anaerobic Fermentation Facility uses a higher-temperature thermophilic process of anaerobic digestion than the mesophilic process used in earlier manure-to-methane plants. The plant is expected to process wastes from 10,000 head of cattle, provide 60 to 100% of the packing plant's steam, and produce enough protein to supplement the feed of 6,000 cattle. Experiments will study how retention time in this process can be shortened, the economics of the process, and whether the dewatered residue will make an effective cattle feed supplement. (Little-East Central)

5669-A5, A8, B2, B3, C2, E2 EFFECTS OF MANURES, AM- MONIUM NITRATE AND S- COATED UREA ON YIELD AND UPTAKE OF N LEVELS IN SOILS IN SOUTHERN QUEBEC

Department of Renewable Resources, Mac-
donald College of McGill University, Ste.
Anne de Bellevue, Quebec HOA 1 C0
P.L. Miller and A.F. MacKenzie
Canadian Journal of Soil Science, V. 58, No. 2,
p. 153-159, May, 1978. 4 tab., 22 ref.

Keywords: Solid wastes, Liquid wastes, Cattle
wastes, Swine wastes, Ammonium nitrate,
Crop response, Soils, Nitrogen, Fertilizers,
Groundwater pollution

Effects of added N in the form of ammonium nitrate, S-coated urea, solid cow manure, liquid hog manure, and liquid hog manure plus straw on yield and N uptake of corn (*Zea mays* L.) were determined in 1971. Residual effects of the fertilizers were measured in 1972. Levels of added N were 150 kg/ha, on three soils varying in texture. In 1971, highest yield and N uptake was found using ammonium nitrate, followed by S-coated urea. The manures were not different than the control, and the average values with liquid manure plus straw were greatest in September. Thus, ammonium nitrate was considered to have the lowest pollution potential, assuming that fall-accumulated inorganic soil N was a hazard for pollution of groundwater. (Miller-McGill University)

5670-B3, C1, C2, D3, E3 THE DIGESTION OF DRY MAT- TER, ORGANIC MATTER AND NITROGEN IN CALVES FED DIETS CONTAINING BROILER- HOUSE LITTER

M.C. Franklin Laboratory, University of Sydney Farms, Camden, N.S.W. 2570, Australia
G.J.L. Jacobs and J. Leibholz
Journal of Agricultural Science, V. 90, Pt. 2, p. 367-373, April, 1978. 5 tab., 16 ref.

Keywords: Refeeding, Poultry litter, Cattle, Ensilage, Performance, Nitrogen, Diets

Four diets were fed to two Friesian bull calves fitted with re-entrant duodenal cannulae. The diets contained no poultry litter (diet 0); 30% poultry litter (diet 30D); 50% poultry litter (diet 50D) or 30% poultry litter which had been ensiled at 45% moisture content for 3 weeks (diet 30W). The total flow of digesta from the abomasum was measured over four 24 h periods for each diet. The flow of dry matter and organic matter to the duodenum was similar on all four diets but the percentage of apparent digestion occurring in the stomach was higher when the diets containing poultry litter were fed. Less nitrogen was digested in the hind gut on diet 30 W than the other three diets. Greater amounts of the nitrogen ingested and also of the nitrogen flowing to the duodenum were apparently digested in the hind gut on the diet containing no poultry litter. Microbial protein synthesized/100 g organic matter apparently digested in the stomach was lowest when the calves were fed the 30 W diet. The results obtained in these experiments were then used to evaluate the results of growth trials previously reported. (Jacobs-University of Sydney Farms)

5671-A6, B2, B4, C2, E2 THE CASE OF THE MISSING FORMS

K. Brown
Hog Farm Management, V. 16, No. 6, p. 14-17, June, 1979. 2 fig.

Keywords: Liquid wastes, Swine wastes, Waste storage, Design, Odor control, Land application, Waste management

Keith Kuhn, a Merville, Iowa pork producer, constructed a gestation building and outside pit to cut down energy requirements, decrease labor requirements, reduce odor and retain a high nutrient value of manure. The gestation building, which used very little heat, had 10 inches of insulation in the ceiling and no pit. Four discharge fans and three fan jets kept the building ventilated. There was almost no odor from the gestation building and outside pit. Labor saving in the system came with the scraper that was controlled automatically by a time clock; the plug that was easily pulled to move the wastes into the pit, and the large pit that needed to be emptied only once a year. The covered, outside pit retained precious nutrients for cropland application. Danger of gas buildup in the pit was reduced by the five pump out holes in the top of the cover and three small access holes to the manure and sow wash lines. (Little-East Central)

5672-B1, E3 TVA'S PROJECTS ON AGRICULTURAL USES OF WASTE HEAT

Tennessee Valley Authority, Division of Agricultural Development, Muscle Shoals,

Alabama
C.E. Madewell, L.L. Behrends, E.R. Burns, J.J. Maddox, D.A. Mays, and R.S. Pile
Paper presented at U.S.-USSR Symposium, Soviet Union, Sept., 1978, 17 p. 11 ref.

Keywords: Livestock wastes, Waste heat, Aquatic systems, Housing, Tennessee Valley Authority, Greenhouses, Crop drying, Food processing, Irrigation

Agricultural waste heat research and development projects under investigation or being planned for investigation by TVA independently or cooperatively with other institutions are discussed in terms of: (1) greenhouses, (2) aquatic systems fertilized with livestock waste, (3) soil heating and irrigation, (4) environmental control for livestock housing, (5) crop drying, and (6) food processing. A multidisciplinary team approach is taken on each agricultural waste heat project. (Merryman-East Central)

5673-A8, A9, E2 EFFECT OF DAIRY MANURE AND SEWAGE SLUDGE ON ^{14}C - PESTICIDE DEGRADATION IN SOIL

Agronomy Department, University of Maryland, College Park, Maryland 20742
R.C. Doyle, D.D. Kaufman, and G.W. Burt
Journal of Agriculture and Food Chemistry, V. 26, No. 4, p. 987-990, July-Aug., 1978. 5 tab., 3 ref.

Keywords: Insecticides, Degradation, Cattle wastes, Land application, Sewage sludge

The degradation of 14 ^{14}C pesticides in sewage sludge and dairy manure amended Matapoke silt loam was investigated. The dairy manure and sewage sludge (80% primary-40% secondary) were applied at rates of 0, 50, and 100 ton/ha, leached to remove excess soluble salts, and incubated (30°C) for 2 weeks prior to application of ^{14}C pesticides. The pesticides were selected as representative of the major pesticide degradation pathways in soil. Total CO_2 and ^{14}C CO_2 evolution were monitored regularly throughout the 60-day incubation period, and ^{14}C -product distribution was determined by soil extraction and thin-layer chromatographic analysis at the end of the incubation period. Altered rates of pesticide degradation were observed in sludge and/or manure amended soils for a number of structurally unrelated pesticides. ^{14}C -product distribution varied with soil amendments. The degradation of pesticides metabolized by dealkylation reactions (e.g., s-triazines, phenylureas, etc.) was inhibited by sewage sludge, but enhanced by manure. (Doyle-University of Maryland)

5674-A10 THE INFLUENCE OF TIME OF DAY, BOVINE MANURE TYPE, AND DISTANCE FROM A BARN ON THE RECOVERY OF FACE FLY AND HOUSE FLY PUPAE

Department of Entomology, University of Kentucky, Lexington, Kentucky 40506
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Environmental Entomology, V. 7, No. 2, p. 246-249, April 17, 1978. 1 fig., 8 ref.

Keywords: Cattle wastes, Flies

A factorial experiment utilizing bovine manure type, time of day, and distance from a barn as the independent variables, showed that the number of house fly and face fly pupae recovered from exposed samples varied in response to their preferred habitat. Analysis of variance showed distance from a barn and manure type to be significant factors influencing house fly pupal recovery while showing all 3 factors to be significant in influencing face fly pupal recovery. Curvilinear regression curves showed the greatest recovery of face fly pupae to be from grass manure and an equal mixture of grass and grain manure exposed at 100, 200, and 300 m from the barn between 9:00 a.m. and noon. House fly pupae were recovered almost exclusively from grain manure samples exposed at 0 m from the barn. Approximately equal quantities of house fly pupae were recovered from the samples exposed at 9:00 a.m., noon, and 3:00 p.m. (Meyer-University of Kentucky)

5675-A10, B3, C3 OVERWINTERING BEHAVIOR OF STABLE FLIES IN MANURE MOUNDS

Veterinary Toxicology and Entomology Research Laboratory, Agricultural Research Service, College Station, Texas 77840
I.L. Berry, K.W. Foerster, and J.B. Campbell
Environmental Entomology, V. 7, No. 1, p. 67-72, Feb. 25, 1978. 3 fig., 1 tab., 9 ref.

Keywords: Flies, Model studies, Larval migration, Temperature

The vertical movement of stable fly larvae in response to temperature gradients in simulated sections of a manure mound was measured and described by a simple model. Temperature gradients in an actual manure mound were recorded and combined with the larval migration model to simulate the migration of overwintering larvae. The data and the simulation indicated that stable fly larvae easily avoid freezing by migrating downwards in manure mounds during the winter. The larvae dispersed so widely in the simulated mound sections that survival of a portion of overwintering larvae seems almost certain. (Berry-ARS)

5676-B2, C3, D3, E3 MICROBIOLOGY OF CORN FERMENTED WITH SWINE WASTE

Northern Regional Research Center, Agricultural Research Service, U.S. Dept. of Agriculture, Peoria, Illinois 61604
L.K. Nakamura and C.D. Crowell
Development in Industrial Microbiology, V. 19, p. 395-402, 1978. 1 fig., 5 tab., 15 ref.

Keywords: Swine wastes, Fermentation, Bacteria, pH, Refeeding

The initial microflora of the swine waste-corn fermentation is a heterogeneous mixture of microorganisms. Yet within 48 to 72 h,

lactobacilli and yeasts constitute the major portion of the total microbial population. Heterofermentative bacteria, very similar to *Lactobacillus fermentum*, are the predominant lactobacilli throughout the fermentation. During the initial 12 h, equal proportions of *Candida krusei* and *Candida valida*-like organisms make up the yeast population. Later populations, however, are dominated by the *Candida krusei*-like yeast. The predominance of the heterofermentative lactobacilli accounts largely for a minimum pH of 4.5. Presumably, this pH value discourages, but does not totally inhibit, multiplication of the coliform bacteria and fecal streptococci. Consequently, small numbers of these bacteria persist throughout the fermentation. (Nakamura-USDA)

5677-A11, B3, B5 SELECTIVE GRAZING INDUCED BY ANIMAL EXCRETA I. EVIDENCE OF OCCURRENCE AND SUPERFICIAL REMEDY

Department of Agronomy and Plant Genetics and USDA, University of Minnesota, St. Paul, Minnesota

G.C. Marten and J.D. Donker
Journal of Dairy Science, V. 47, p. 773-776, 1964. 3 tab., 8 ref.

Keywords: Dairy cattle, Cattle wastes, Pasture management, Forages, Grazing, Performance, Molasses, Sugar

Recurring grazing patterns by dairy heifers and steers under rotational grazing of brome and alfalfa-brome were measured by mapping within staked areas over a 2-year period. An average of 81% of all dung deposited by the animals 3 to 4 wk before grazing caused complete refusal of the forage in the area. Complete refusal of dung-affected forage was reduced to 68% after two to three months. Dung deposited on brome caused a greater refusal of forage than that deposited on alfalfa-brome. Of all areas not grazed, 93% contained dung spots from periods prior to measurement, while only 1% of completely consumed forage areas contained dung. The effect of sprayed sugar or molasses on consumption of dung-affected brome was measured in 1961. Both sweetening agents resulted in consumption of grass over dung spots, while untreated controls remained ungrazed. Molasses was more effective than sugar in completely overcoming rejection of dung-affected forage. (Marten-University of Minnesota)

5678-B2, C2, C3, D1, C3, E4 CHICKEN MANURE TO CHICKEN FEED: A RECYCLING OF AGRICULTURAL NUTRIENTS

M.L. Shuler
Engineering Cornell Quarterly, V. 12, No. 1, p. 25-31, Spring, 1977. 7 fig., 1 tab.

Keywords: Poultry wastes, Refeeding, Single cell protein, By-product recovery, Centrifuging, Dehydration, Nitrogen, Carbon, Amino acids, Toxicity, Pathogenic bacteria

In May, 1976, Cornell received from NSF-RANN a two-year grant to study the economic, microbial, and nutritional feasibility of a

controlled microbial process for the conversion of poultry manure into a single-cell protein refeeding product for hens. The first stage for conversion is the breakdown of uric acid into ammonium ion by micro-organisms. This results in a substantial increase in biomass. In the second stage, fixed nitrogen and carbon from the first stage are converted into biomass which is largely protein. Since the effluent from the first stage is rich in fixed nitrogen but poor in carbon, glucose (a carbon source) is added to balance the concentration of nutrients. The cell-rich effluent must then be sent to a recovery system where the solids can be removed from the liquid. A feasible method would be to centrifuge the second-stage effluent and dry the solids. The liquid would be recycled to effect a more complete conversion of the fixed nitrogen and carbon from the first stage. The cell-rich effluent must then be sent to a recovery system where the solids can be removed from the liquid. A feasible method would be to centrifuge the second-stage effluent and dry the solids. The liquid would be recycled to effect a more complete conversion of the fixed nitrogen and carbon into cellular protein. The liquid purge is necessary also to control the concentration of any compounds that might build up to toxic levels. The effluent is then sent to a grit separator for grit removal. Utilizing the system outlined, it is anticipated that 90% of the fixed nitrogen in poultry manure could be recovered to yield a product containing about 40 to 50% protein, 8.6% of which is lysine and 3.2% of which is methionine - two very important amino acids in poultry diets. Future studies will investigate carbon sources other than glucose (which is too expensive) and will monitor toxic compounds and pathogenic organisms which build up during the liquid recycle. (Merryman-East Central)

5679-A11, B1, E3, F1 PRODUCTION OF TILAPIA HYBRIDS WITH CATTLE MANURE OR A COMMERCIAL DIET

Department of Fisheries and Allied Aquacultures, Auburn University, Agricultural Experiment Station, Auburn, Alabama 36830

W.J. Collis and R.O. Smitherman
Symposium on Culture of Exotic Fishes, Fish Culture Section, American Fisheries Society, Atlanta, Georgia, Jan. 4, 1978, p. 43-54. 2 fig., 5 tab., 13 ref.

Keywords: Refeeding, Cattle wastes, Tilapia, Fish farming, Performance

Two treatments, each with three replications, were stocked with all male hybrids (*Tilapia nilotica* x *T. hornorum*) at the rate of 10,000 fish/ha on 13 June 1977 in 400 m² earthen ponds. Treatment 1 received manure (19% crude protein) collected daily from cattle raised in confinement, while treatment 2 received a commercial catfish diet (36% crude protein). Fish were fed isonitrogenous amounts of manure or commercial diet twice daily. After 63 culture days, declining oxygen in the manure treatment forced reduction of the manure inputs from 94.8 kg/ha/day to 81.1 kg/ha/day on a dry matter basis, until the termination of the experiment on 23 September. Over a period of 103 days, adding 26,381 kg/ha of fresh manure (5382 kg/ha dry matter) resulted in an average production of 18.0 kg/ha/day while 3521 kg of commercial diet gave 25.8 kg/ha/day; net yields were 1648 kg/ha and 2863 kg/ha, respectively. Conversion rates based on dry matter inputs/gain and crude protein inputs/gain were 3.3 and 0.62 for the manure treatment, and 1.3

and 0.48 for the commercial diet. Stomach analysis of the fish fed manure showed that manure was used directly as a feed. Organoleptic evaluation showed no significant difference ($P > 0.05$) in taste and texture between fish sampled from treatments receiving manure or commercial diet. Under certain conditions, returns above feed costs for producing hybrid tilapia using cattle manure could be similar to returns from production with a commercial catfish diet. (Collis-Auburn University)

5680-A11, B2, D1, D3, E3 TILAPIA PRODUCTION IN PONDS RECEIVING SWINE WASTES

Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843

R.R. Stickney and J.H. Heagy
Symposium on Culture of Exotic Fishes, Fish Culture Section, American Fisheries Society, Atlanta, Georgia, Jan. 4, 1978, p. 90-101. 1 fig., 3 tab., 47 ref.

Keywords: Swine wastes, Poultry wastes, Lagoons, Fish farming, Tilapia, Waste treatment, Refeeding, Recycling, Performance

The emphasis of aquacultural research on tilapia in Texas has been focused on *Tilapia aurea*. Preliminary investigations have been conducted to determine the protein requirements of this species with most of the research centered on the production of *T. aurea* in ponds receiving swine and poultry wastes. The tolerance of *T. aurea* to poor water quality allows this species to survive under conditions which might be lethal to more traditional United States aquaculture fishes. Rapid growth will occur in *T. aurea* reared in ponds receiving input directly from swine or from primary settling ponds. Fish produced in waste lagoons can be utilized as human food or to supplement the diets of livestock. (Stickney-Texas A&M University)

5681-A11, B2, D3, E3 ALGAE-SWINE MANURE SYSTEM FOR PRODUCTION OF SILVER CARP, BIGHEAD CARP, AND TILAPIA

Tennessee Valley Authority, Muscle Shoals, Alabama

J.J. Maddox, L.L. Behrends, C.E. Madewell, and R.S. Pile
Symposium on Culture of Exotic Fishes, Fish Culture Section, American Fisheries Society, Atlanta, Georgia, Jan. 4, 1978, p. 109-120. 6 tab., 14 ref.

Keywords: Swine wastes, Fish farming, Waste treatment, Refeeding, Recycling, Algae, Performance

Growth of naturally occurring algae species as a result of swine manure fertilization has been studied. Seasonal changes in species of algae have been observed. A 5-day growth period with manure diluted 340 times and used daily has proven successful to produce plankton in the summertime. Yield trials using this algae were conducted with silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), and tilapia (*Tilapia nilotica*). Silver

carp in monoculture gained 253% and had a 79% survival in a 72-day study in 1976. A polyculture yield trial (52 days) was conducted in 1977 with all three species to measure their cumulative growth when fed algae exogenously produced and fertilized with swine manure, compared to growth produced by an equivalent amount of manure introduced directly into the fish culture. Fish production was 1.8 times greater when manure was introduced directly into the fish culture. The interaction between feeding rate and stocking rate was tested in a 30-day experiment in water warmed to 25°C during March 1977. Fish grew best when stocked at 6 g per 100 liters and fed algae daily at the rate of 6% (dry weight basis) of the initial fish stock weight. Results are discussed with respect to cultural problems encountered and the potential for using such systems in warm waters discharged at power plants. (Maddox-Tennessee Valley Authority)

5682-A11, B2, D3, E3 POLYCULTURE OF CHINESE CARPS IN PONDS WITH SWINE WASTES

Illinois Natural History Survey, Kinmundy, Illinois
H. Buck, R.J. Baur, and C.R. Rose
Symposium on Culture of Exotic Fishes, Fish Culture Section, American Fisheries Society, Atlanta, Georgia, Jan. 4, 1978, p. 144-155. 6 tab., 24 ref.

Keywords: Swine wastes, Waste treatment, Refeeding, Fish farming, Recycling, Performance, Chinese carp

Through three growing seasons swine houses were situated so that the wastes dropped directly into ponds stocked with silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), grass carp (*Ctenopharyngodon idella*), the Israeli variety of the common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), and either the northern largemouth bass (*Micropterus salmoides salmoides*), or the bluegill (*Lepomis macrochirus*). Two ponds were used in 1975, four in 1976 and 1977. The ponds were contiguous and ranged in size from 0.08 to 0.10 ha. Densities of pigs ranged from 39 to 85/ha of pond area. Two consecutive lots of pigs were fattened over each pond in the April to October period of each season. The sole addition of nutrients to the ponds were the swine wastes. Water levels were lowered at mid-season in 1975 and 1976 to improve natural circulation, and were lowered and later raised in 1977, but conditions were otherwise static, with no artificial aeration or circulation. Experimental fish populations varied in total densities in 1976, and in densities of silver carp in 1977. Fish densities ranged from 1063 to 9199/ha. The most commonly used, or "standard" ratio, was 39 silver carp to 13.3 Israeli carp to 3.3 bighead carp to 1 grass carp to 1 channel catfish. Over growing periods of from 170 to 197 days gains in fish biomass ranged from 786 kg/ha in a control pond which received no wastes to a maximum of 4585 kg/ha. Production of bighead carp was inversely correlated with that of silver carp, but gains in biomass by Israeli carp were directly correlated with total gains made by silver carp. Evidence was gained that there is an optimum density of carps, one large enough for effective nutrient removal, and efficient protein production, but not so large as to create undesirable levels of turbidity or metabolites. A total mortality occurred in one pond in late-season, 1976, but

water quality was in most cases adequate for the survival of largemouth bass, or the reproduction and survival of bluegill. (Buck-Illinois Natural History Survey)

5683-B5, C2, E2 SEQUENTIAL REDUCTION OF NITRATE AND NITROUS OXIDE UNDER FIELD CONDITIONS AS BROUGHT ABOUT BY ORGANIC AMENDMENTS AND IRRIGATION MANAGEMENT

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D.D. Focht, L.H. Stolzy, and B.D. Meek
Soil Biology and Biochemistry, V. 11, No. 1, p. 37-46, 1979. 10 fig., 4 tab., 36 ref.

Keywords: Land application, Irrigation, Cattle wastes, Nitrates, Nitrous oxide, Denitrification

The effect of organic amendments and irrigation management in the field were studied with respect to E_p , NO_3^- , and soluble organic C concentrations in the soil solution, and gaseous concentrations of N_2O , CO_2 , and the ratio N_2 to O_2 . Duplicate plots were treated with fresh bovine manure as follows: control 45 t.ha⁻¹, 180 t.ha⁻¹ with a standard irrigation cycle (SI), and 180 t.ha⁻¹ with a double irrigation (DI). Samples to 230 cm were obtained at several depths in each profile during the 84-day study. The general order for treatment effects upon CO_2 concentrations and soluble C was the same: SI > DI > 45 t.ha⁻¹ > control. The order for N_2/O_2 was 180 t.ha⁻¹ (SI and DI) > 45 t.ha⁻¹ and control. The order for both N_2O and NO_3^- was the same: 45 t.ha⁻¹ and DI > SI and control. The most important factor affecting N_2O concentrations was the NO_3^- concentration: soil solution concentrations greater than 16 $\mu g N.ml^{-1}$ had much higher frequencies of high N_2O concentrations. The sequential reduction of $NO_3^- \rightarrow N_2O \rightarrow N_2$ was noted in all treatments by the following observations: (i) the concentrations of both NO_3^- and N_2O were highest at the beginning of the experiment; (ii) the concentrations of CO_2 and N_2/O_2 were higher near the end; (iii) sub-ambient concentrations of N_2O were more frequent near the end of the study. Use of N_2O as an indicator of denitrification is cautioned since one of the highest manured treatments (SI) had N_2O concentrations no different than the control, but had much higher CO_2 and N_2/O_2 concentrations and more reduced (E_p) conditions. We conclude that use of single irrigation method is far superior to the double irrigation method with respect to reducing losses of NO_3^- and N_2O and for conserving organic N and water. (Focht-University of California)

5684-A11, B2 ISOLATION OF MYCOPLASMA ARGININI FROM SWINE AND FROM A SWINE WASTE DISPOSAL SYSTEM

Veterinary Medical Research Institute, Iowa State University, Ames, Iowa 50011
A.P. Orning, R.F. Ross and M.F. Barile

American Journal of Veterinary Research, V. 39, No. 7, p. 1169-1174, 1978. 2 fig., 5 tab., 33 ref.

Keywords: Swine wastes, Lagoons, Animal health, Swine, Wastewater reuse, Anaerobic, Sewage system

Mycoplasma arginini was isolated from the pharynx and tonsils of 4 to 6 swine necropsied during an epizootic of respiratory tract disease and lameness. The organism was also isolated from 2 of 16 asymptomatic swine examined in the same herd approximately 10 months after the epizootic. In addition, *M. arginini*, *Acholeplasma laidlawii*, and other *Acholeplasma* were isolated from recycled effluent of an anaerobic lagoon used for disposal of waste from the swine herd. This observation represents the 1st report of a *Mycoplasma* species isolated from a lagoon or sewage system. The pathogenicity of a strain of *M. arginini* isolated during the epizootic was examined by inoculating young swine intranasally, intratracheally, intravenously, and intraperitoneally. The agent colonized in the pharynx of 2 pigs inoculated intranasally, but did not produce overt signs of clinical disease. Although neutralizing antibodies to *M. arginini* were detected, 1 animal that had been infected naturally and 2 that had been inoculated intravenously did develop complement-fixing antibodies. The findings indicate that *M. arginini* can colonize in the nasal and pharyngeal mucosae of swine, but that it is not highly pathogenic for these animals. (Orning-Iowa State University)

5685-A5, A8, C1, E2 A NEGATIVE INFLUENCE OF MANURE ON CALCAREOUS SOILS

Institut de Technologie Agricole, Mostaganem, Algeria
C. Richter, F. Van Der Pol, and A. Martiere
Plant and Soil, V. 50, No. 2, p. 515-520, 1978. 2 fig., 11 ref.

Keywords: Farmyard wastes, Soils, Irrigation, Leaching, Land application, Soil-water-plant relationships

It was found that application of farmyard manure might intensify the formation of calcareous crusts. A soil rich in $CaCO_3$ in a semiarid climate in Algeria formed a hard soil layer in a depth of 20-40 cm after farmyard application and irrigation. The layer was impermeable for plant roots. Soil samples and leaching experiments revealed that much more Ca -ions and HCO_3^- -ions were leached out of soils with farmyard manure application than from soils without manure. It is recommended that limy soils in a dry climate be fertilized often with small quantities instead of rarely with big quantities of farmyard manure in order to avoid formation of calcareous crusts. (Little-East Central)

5686-B3, C1, C2, C3, D1, D3 THE SUPPLEMENTATION OF HORSE MANURE COMPOST AND SYNTHETIC COMPOST WITH CHICKEN MANURE AND OTHER NITROGEN SOURCES

Mushroom Experimental Station, Horst (L), the Netherlands
J.P.G. Gerrits
Mushroom Science, V. 9, Pt. 2, 1977.
Proceedings of the Ninth International Scientific Congress on the Cultivation of Edible Fungi, p. 77-98, 1974.

Keywords: Horse wastes, Poultry wastes, Urea, Compost, Ammonia, Nitrogen, Carbon, pH

Chicken manure and urea were added to fresh horse manure in various quantities to find the optimum amount to be added to the compost. Ammonia was determined in most of the composts, to get an idea about the "available" C/N ratio. Sometimes almost no chicken manure was needed, whereas in other loads 200 kg of chicken manure per ton of fresh horse manure was optimum. The average optimum supply of chicken manure under Dutch conditions was 100 kg per ton of fresh horse manure. The ammonia content and the pH at filling gave a good indication of the amount of nitrogen supplied to the compost. With a 10-day pasteurization, optimum results were obtained with an ammonia content of 0.4% and a pH of about 8.3. Chicken manure, urea and calcium ammonium nitrate can replace each other. As far as the optimum ammonia concentration and the pH were concerned, horse manure compost and synthetic compost yielded the same results. (Little-East Central)

5687-B2, C1, D1, F1 CONTINUOUS GRAVITY FLOW SLURRY CHANNELS

Scottish Farm Buildings Investigation Unit
J.P. Cermack
Farm Building Progress, V. 37, p. 21-23, July, 1974. 2 fig., 1 tab., 5 ref.

Keywords: Slurries, Continuous gravity flow, Dry matter, Economics, Design

One of the methods for removing slurry from underneath a slatted floor is by continuous gravity flow, where slurry is pushed out of the building by its own weight. The system is designed to cope with slurry of 8-14% DM (dry matter) content which is often obtained from zero-grazed and silage-fed animals. The action of self-emptying slurry channels is based on utilization of the physical properties of slurry. It is important to consider the DM content of slurry when designing a system. Advantages of continuous gravity flow are: (1) 10% cheaper construction costs than traditional deep slurry cellar systems, (2) suitable for hard rocky sites where excavation is expensive, (3) no agitation of slurry required within the building, (4) no energy is required to remove slurry from the building, (5) no smells from decaying slurry, (6) no maintenance, and (7) cheap slurry storage near the building. (Little-East Central)

5688-A5, A8, C3, E2 THE APPLICATION OF LIQUID PIG MANURE. ITS AGRONOMIC EFFECTS

Station d'Agronomie, I.N.R.A., 29000 Quimper
M. Coppenet

Annales Agronomiques, V. 25, No. 2-3, p. 403-423, 1974. 5 tab., 30 ref.

Keywords: Land application, Swine wastes, Liquid wastes, Soil chemistry, Nitrogen, Groundwater pollution, Copper, Zinc, Toxicity, Crop response, Fertilizers, Leaching

The deduction of the mineral composition of liquid pig manure by means of calculating the food balance appears to be a valid method, considering the difficulties encountered with direct analysis. Liquid pig manure is richer in P_2O_5 than in K_2O (13 compared with 1.0) contrary to liquid bovine manure which is much richer in K_2O than P_2O_5 (2-3 times richer). We are of the opinion that the non-diluted liquid manure of pigs when first applied to the soil, has approximately the following composition: 90-100 p. 1000 dry matter; 5.5 p. 1000 total N, 4 p. 1000 P_2O_5 ; 3 p. 1000 K_2O . A pig farmer possessing 14 pigs per hectare of land and using his own maize is obliged to purchase soya oil-cake and a mineral complement, which once it has passed into the excrement, produces a positive balance of P_2O_5 (+70 kg/ha) and K_2O (+30 kg/ha). With regard to nitrogen, the balance is probably slightly negative owing to losses by volatilization of ammonia. The farmer working in this way, but who, in addition, purchases sufficient commercial foodstuff for 50 pigs per hectare (100m²/ha/year of non-diluted liquid manure with 5 p. 1000 total nitrogen) has a positive annual balance of his land of 400 kg/ha N, 350 kg/ha P_2O_5 , 250 kg/ha K_2O if he grows maize after maize only. Furthermore, this level of nitrogenous fertilization can only be accepted by intensive leys of Graminaeae. Where maize only is cultivated, an annual excess of 400 kg/ha N incurs the risk of producing excess soluble salts in some zones of the topsoil, according to the method of manuring, to say nothing of the quantity of nitrates which will pass into the drainage water of the Finistère region and which could raise the underground water content beyond 10 mg/l nitrate nitrogen. With regard to the usual chemical analysis carried out on the soils of these intensive farms which already indicate a large increase in the amounts of available P_2O_5 , it is advisable that, in addition, tests on the electrical conductivity of the aqueous extracts be performed. The introduction of feeds supplemented by up to 150 and even 250 mg Cu per kg foodstuff gives rise to the problem of the return to the soil of the quasi-totality of the copper. It can be calculated that 100 m³/ha/year liquid manure with 78 p.p.m. Cu results in the soils becoming toxic, for some crops, only after a period of 80 years. When the mineral complement also contains zinc, it is calculated that zinc toxicity alone could occur after 110 years. In the case of both toxicities combined, this grave possibility could occur before a hundred years. Under the conditions prevailing in Brittany, it seems to us that the dangers due to the application of liquid pig manure are only likely to become apparent in the future when 50 m³/ha/year is exceeded (non-diluted liquid manure with about 5 p. 1000 total nitrogen) i.e. on farms with more than 30 porkers per hectare of farm land in use. (Coppenet-Station d'Agronomie) (Article in French)

5689-A9, A12, C2, E3 RECYCLING ANIMAL MANURE AS A FEEDSTUFF

Anonymous
Agriculture and Environment, V. 4, No. 2, p. 155-157, August, 1978. 14 ref.

Keywords: Refeeding, Animal wastes, Animal health, Performance, Contaminants

The possibility of recycling animal manure as a feed ingredient for animals in order to provide a source of nutrients while minimizing potential waste pollution was discussed. A review of the literature indicates that animal manure recycled as a feedstuff can be utilized well with no adverse effect on animal performance if the manure is included as a small proportion of the total feed. The main concerns of the Food and Drug Administration (FDA) are the potential hazards due to contamination by pathogens, antibiotics, pesticides, hormones, trace elements, nitrofurans and other chemicals that might be present in animal manure. The social aspect of feeding animal manure is also important. There is, however, a lack of information about the repercussions of using the meat of animals fed manure produced for human consumption. (Little-East Central)

5690-B1, B2, B4, E2, F1 BELOW SLAT FLUSHED FLOORS FOR GROWING-FINISHING PIGS

Scottish Farm Buildings Investigation Unit
A.M. Robertson
Farm Buildings Progress, V. 44, No. 13, p. 13-15, April, 1978. 2 fig., 2 tab., 5 ref.

Keywords: Swine wastes, Slurries, Design, Flushing, Economics, Swine, Confinement pens, Land application, Waste storage

Totally slatted or part-slatted floors have been widely adopted in housing for growing-finishing pigs as a method of reducing labor requirements. Although the installation of slats may eliminate daily labor for cleaning, other objectives must be considered. Reduction in channel depth, daily or more frequent removal of slurry from the building or storage outside the building are methods of achieving the required alternatives. A system which appears to offer all the benefits without the disadvantage of installing mechanical scrapers in below-slat channels is that of flushing. The flushing system consists of a flushing tank which discharges automatically when full, and a shallow channel below the slatted floor. The flushing tank can be mounted to tip forward into the below-slat channel, or in long houses it can be elevated and made to discharge backward on to a curved concrete spillway. The flushing channel should have a 2% slope and be level from side to side. Supernatant liquid from a lagoon or liquid from which solids have been removed, either by gravity or mechanically, is ideal for flushing. Flushing should be carried out three times a day at eight hour intervals in buildings where waste accumulates rapidly. Costs of waste handling and storage for systems were given. (Little-East Central)

5691-A6, A7, A10, A11, A12, B1, C1, C2, C3 AIRBORNE DUST CONCENTRATIONS ASSOCIATED WITH ANIMAL HOUSING TASKS

Scottish Farm Buildings Investigation Unit
J.P. Cermack and P.A. Ross
Farm Building Progress, No. 51, p. 11-15, Jan., 1978. 7 tab., 6 ref.

Keywords: Dusts, Measurement, Confinement pens, Public health, Vectors, Odor, Hydrogen sulphide, Ammonia, Aliphatic aldehydes, Mercaptans, Amines

The results of measurements of dust concentrations taken in animal housing units in the north-east of Scotland are given. Dust in livestock housing consists of small particles of solid matter, soil, feeds, animal hair and skin, spores, and dry fecal material dispersed by air currents in the form of dust clouds which settle on various surfaces. Inhalation of dust can lead to respiratory disorders, toxic effects and to allergic reactions. The origin, particle size, level of aerial contamination, and the length of exposure to dust determine the health hazard and anatomical parts of both man and animal likely to be affected. Dust particles are considered to act as vectors of viruses or bacteria, especially of respiratory diseases. Therefore, removal of dust and microorganisms from the air within the building is a primary function of ventilation. The main substances which cause odor pollution are hydrogen sulphide, ammonia, aliphatic aldehydes, mercaptans and amines. Fine grain dust deposited around farm structures and machinery is a potential fire hazard. Dust extracting equipment and personal protection should be considered in the prevention of health hazards. It is possible to detect sensitization reaction in workers exposed to spores and organic dust, well before any permanent lung damage has occurred. A dust concentration equivalent to 10 mg/m³ of air was suggested as a general nuisance threshold limit. (Little-East Central)

5692-B2, B3, C2, D2, E2 FERTILIZING BERMUDAGRASS WITH ANIMAL WASTES

Southern Piedmont Conservation Research Center, Watkinsville, Georgia 30677
S.R. Wilkinson, R.N. Dawson, and A.P. Barnett
Sixth Research Industry Conference, Coastal Bermudagrass Processors' Association, Inc., Russell Research Center, Athens, Georgia, p. 21-34, 1978, 2 fig., 9 tab., 5 ref.

Keywords: Liquid wastes, Solid wastes, Cattle wastes, Swine wastes, Poultry wastes, Land application, Forages, Nitrogen, Phosphorus, Potassium, Fertilizers, Pastures

Study objectives are: To discuss animal wastes as fertilizers, to present research results showing forage yield responses of bermudagrass (*Cynodon dactylon* (L.) Pers.) to solid and liquid dairy cattle manure, swine lagoon effluent, and solid poultry manure, and to make general recommendations for its use in the production of bermudagrass forage. The amount of animal waste to be applied depends on the amount available, its N concentration and water content, its N availability, climatic and soil conditions, and the N required by the crop for the desired level of productivity. Since manure is usually wet, the actual rate must be converted to a wet weight basis. Research data are given showing the response of bermudagrass to animal waste application in North Carolina, Alabama, and Georgia. Recoveries usually decrease rapidly with an accompanying risk of excessive nitrate loss when N input rates exceed 600 lbs/A/yr N. There is the possibility of buildup of available N when using organic nitrogenous wastes. For most efficient use of nutrients in animal waste, overall rates of waste application may need to be decreased in succeeding years of applica-

tion. Animal wastes are good sources of phosphorus (P), and potassium (K), as well as other essential plant nutrients. It was recommended that animal wastes be applied at moderate rates on a larger Coastal acreage using additional N from commercial fertilizers, rather than satisfying the entire N requirement with wastes. The beneficial effects of manure as compared with commercial fertilizers would be more noticeable on the proper land, therefore it is advisable to use manure on poorer land. (Little-East Central)

5693-A3, A8, B2, C1, C2, C3, E2 EFFECTS OF SOIL INJECTION OF LIQUID DAIRY MANURE ON THE QUALITY OF SURFACE RUNOFF

University of Kentucky, Water Resources Research Institute, Lexington, Kentucky
I.J. Ross, S. Sizemore, J.P. Bowden, and C.T. Haan
Research Report No. 113, University of Kentucky Water Resources Research Institute, August, 1978, 66 p. 49 fig., 1 ref.

Keywords: Land application, Soil injection, Liquid wastes, Dairy wastes, Agricultural runoff, Water pollution, Soil contamination, Nitrates, Solids, Chemical oxygen demand, Dissolved oxygen, Coliforms

Liquid dairy manure has been injected on the soil contour to depths of 6 and 12 inches and applied to the surface of a Bluegrass sod and a bare tilled soil. Application rates of 9,250 gallons per acre were used. Runoff from 9-foot-square plots which were sprinkled at rates of 2.5 inches per hour on sod and 1.5 inches per hour on bare soil was collected and analyzed for various pollution parameters including COD, N, TS, TSS, pH, DO, and Fecal Coliform. The effects on pollutant yield in the runoff have been determined for various treatments. Injection of the manure into the soil essentially eliminated any pollutant yield in the runoff from the test plots as compared with surface application. Also, injection tended to even the rate of pollutant loss in the runoff. The delay-time between application of liquid manure and the simulated rainfall event significantly decreased the yield of pollutants in the runoff. Repeated yearly applications of manure on sod reduced pollutant concentration in runoff and also reduced runoff rates. Test results indicate that pollutant concentration in runoff is a function of the concentration in the liquid manure and the total quantity of runoff. (Ross-University of Kentucky)

5694-B2, B3, C2, C3, D3, E3 METHODS TO RECOVER NUTRIENTS AND ENERGY FROM SWINE MANURE

Department of Agricultural Engineering, Oregon State University, Corvallis, Oregon
L. Boersma, E. Gasper, J.E. Oldfield, P.R. Cheeke, and J.R. Miner
Special Report 543, Agricultural Experiment Station, Oregon State University, May, 1979, 41 p. 5 fig., 4 tab., 9 ref.

Keywords: Swine wastes, Recycling, Algae, Biogas, Protein, Fermentation, Design, Digesters, Anaerobic, Methane, Bacteria

Disposal of manure is a major problem, yet manure could be a valuable resource. It is a source of digestible organic material, plant nutrients, and protein. This report describes methods for the recovery of energy and protein from swine manure. Energy and material balances are presented for several management systems with emphasis on one designed to maximize recovery of biogas and a second one designed to maximize recovery of protein. Analyses compare the energy needed to produce the feed for 100 pigs and raise them with the energy which can be derived from the manure discharged by these pigs. The protein needs of the 100 pigs are compared with the protein which could be recovered from the manure by means of fermentation processed or by growing algae. Since the C/N ratio of the manure is low, yield of biogas and protein can be increased by adding properly treated straw. On-farm energy needs are about 85 Mkal/yr (million kilocalories per year). When biogas recovery is emphasized, the manure yields 38 Mkal/yr without straw added and 121 Mkal/yr with straw added. The protein needs are about 13,000 kg/yr. A farmer could recover 27 Mkal/yr of biogas and 4,000 kg/yr of protein or 59 Mkal/yr of biogas and 6,500 kg/yr of protein with straw added. Interpretations of data in the report should be made with care. The proposed systems have not been operated under "real world" conditions. The report presents potential processes that have considerable promise for successful development through further research. It does not give an account of existing technology. (Boersma-Oregon State University)

5695-A8, B2, B5, E2 DEVELOPMENT OF MECHANIZATION FOR THE EFFICIENT INJECTION OF LIQUID SLURRY WASTES INTO AGRICULTURAL SOILS

Department of Agricultural Engineering, Macdonald Campus of McGill University, Ste. Anne de Bellevue, Quebec
S. Negi, E. McKyes, R.J. Godwin, and J.R. Ogilvie
Report to: Agriculture Canada Engineering Research Services, DSS Contract RN: 01843-5-0042, FC 1-1850-000-000-0413, Serial OSW5-0287, Nov., 1978, 111 p. 52 fig., 18 tab., 123 ref.

Keywords: Design, Slurries, Soil injection, Equipment-soil injection

The design criteria for slurry injectors are derived considering the horizontal and vertical force requirements, the soil volume to be disturbed and the biological and environmental requirements of the injection process. An example injector is designed for a typical application. Laboratory data on the draft requirements, the area of soil disturbed and covering characteristics of model injectors are obtained and the salient features of these data are emphasized. The results of the draft force tests under field conditions are shown to be in good agreement with the predicted values. The injection tool is purposely designed to cut, lift, disturb and redeposit sufficient soil and mix it quite well with the manure in layers up to 6 inches thick and to cover it with a stable soil structure. Field test results from prototype models are demonstrated to verify force requirements and slurry distribution and cover performance of these devices. (Negi-McGill University)

5696-A10 DISTRIBUTION AND RELATIVE

ABUNDANCE OF DIPTEROUS PUPAE AND THEIR PARASITOIDS IN ACCUMULATIONS OF DOMESTIC ANIMAL MANURE IN THE SOUTHWESTERN U.S.

E.F. Legner and G.S. Olton
Hilgardia, V. 40, No. 14, p. 505-535, 1971. 22 fig., 14 ref.

Keywords: Animal wastes, Parasites, Flies

Populations of the parasitoid species attacking dipterous hosts in accumulations of domestic animal manure in the southwestern United States may be divided into three major geographical groups, (1) those widespread in areas below 2,000 meters, (2) those restricted to the warmer climatic areas and (3) those restricted to higher latitudes and colder winter climates. The first group contains the two species of *Muscidifurax* and *Spalangia nigroaenea*. Group II contains *Spalangia endius* and *S. cameroni*; and Group III, *Spalangia nigris* and *Aleochara* species. It is not known if one of the restricting factors in species distribution is a direct or an indirect effect of climate on manure composition. Also, within each parasitoid and host population, considerable yearly variation occurs in the abundance of "demes", as evidenced by seasonal studies of hen manure. Parasitoid demes also vary in abundance according to the availability of hosts at any particular site. Therefore, since most host-breeding sites are in themselves very unstable, differing in composition as animal diets differ, as breed and age of animals change, and as weather conditions vary, so instability occurs among parasitoid demes. Some cease to exist where they were large in a previous year. Others appear where they had not existed before. Much of this appearance and disappearance may be due to migration — an important element in the panmictic nature of most populations. Some parasitoids, such as the Diapriidae and the Staphylinidae, appear to be local species that have adapted to some of the dipterous pupae. Species in these groups change among localities and probably consist of small demes. *Fannia canicularis* is presently Holarctic in distribution, but most certainly did not originate in the southwestern United States. Either *Stilpnus* followed its host out of another portion of the Nearctic or Palearctic, or it became adapted to *F. canicularis* from some related native *Fannia* species. Yet *F. ferox*, an apparent invader from South America, has not acquired any similar specific parasitoid. Evidence appears to favor the theory of invasion of both host and parasitoid into the Southwest. The obvious function of parasitoid species as irreplaceable mortality factors in the populations of their dipterous hosts, indicates their value as natural control agents. Consideration of their presence is indispensable if their dipterous hosts are to be deliberately reduced. (Legner; Little, ed.)

5697-C2, E3, F1 ALTERNATIVE FEED RESOURCES FOR ANIMAL PRODUCTION

Department of Animal Science, Ruminant Nutrition, Iowa State University of Science and Technology, Ames, Iowa 50011
R.L. Vetter and M. Boehlje
Paper No. J-9085, Project 2059, Iowa Agriculture and Home Economics Experiment Station, p. 95-128. 24 tab., 25 ref.

Keywords: Refeeding, Crop residues, Cattle wastes, Poultry wastes, Swine wastes, Sheep wastes, Poultry litter, Economics, Forestry residues, Calcium, Phosphorus, Potassium, Protein

Varied estimates were provided for the quantity of total and available agricultural residues. Distribution and use profiles were developed by regions and class of livestock. The quantity of waste and residue materials that will be utilized in livestock production depends upon the cost, availability, and nutrient characteristics of these materials in comparison with alternative feedstuffs. Estimates of utilization were obtained by determining the least-cost rations for livestock production, with crop residue and livestock waste materials as potential substitutes for traditional feedstuffs. The results suggest that even with very low corn silage and shelled corn prices, corn stover is a key ingredient of the least-cost-beef-cow maintenance ration in the Midwest. Analyses were also completed of the potential utilization of cattle excreta stover by beef cows. With \$11 per ton cattle excreta stover, and current prices for other feedstuffs, a total of 57.5 lb (as-fed) of excreta stover was included in the daily least-cost ration. With excreta stover priced above \$17 a ton, it is not a competitive feedstuff in the least-cost ration, and the nutrient requirements of the beef cow are satisfied by hay. Poultry and cattle excreta materials were included along with conventional feedstuff in an analysis of least-cost cattle finishing rations. The data indicate that cattle excreta stover can be an economically competitive feedstuff in many cattle feeding rations even at current prices, particularly during the growing phase of the feeding program. Broiler litter at \$10 per ton was included in ration at maximum level, but dropped to supplemental level at \$30 per ton. Further analyses were completed by assuming that cattle excreta with various characteristics are separate feed ingredients and can be combined in the ration in various proportions, depending upon the costs or prices of excreta relative to other ingredients. Thus, it seems that significant volume of cattle excreta materials could be economically utilized in cattle finishing rations with a price between \$5-\$10 per ton of as-fed material in the Corn Belt and Inter-mountain states and significance for future livestock production. The best use would seem to be directed towards the fabrication of new products and for energy. (Vetter-Iowa State University)

5698-A8, E2 EFFECT OF CONTINUOUS APPLICATION OF MANURES, FERTILIZERS, AND LIME ON SOME PHYSICO-CHEMICAL PROPERTIES OF ACIDIC RED LOAMS OF BIHAR

Agricultural Research Institute, Kanke, Ranchi, Bihar, India
C.R. Prasad, R. Prasad, K.K. Jha and S.C. Mandal
Bulletin of the Indian Society of Soil Science, V. 11, p. 253-259, 1976. 1 fig., 3 tab., 8 ref.

Keywords: Animal wastes, Animal wastes, Fertilizers, Lime, Cropping, Phosphates, Solubility, Soil properties, Crop response

Effects of continuous cropping and long term application of manures and fertilizers under lime and no lime conditions were studied. Resulting physico-chemical properties of acid-

ic red loams of Bihar and changes in yields of maize and wheat were evaluated. It was found that lime along with fertilizers or manure gave higher yields of crops than the corresponding treatments without lime. Phosphates increased crop yields in the acidic red loams of Kanke. Liming acid soil seemed to accentuate the oxidation of organic matter of the soil as compared to the corresponding treatment without lime. When the solubility analogues of fluorapatite-fluorite, hydroxyapatite and octacalcium phosphate forms of minerals were compared with lime and phosphate potential values, they showed the solubilities in the order $L \gg FYM \gg PK \gg L \gg NPK \gg FYM \gg P \gg FYM = FYM \gg PK = NPK \gg NP \gg N$. (Little-East Central)

5699-A11, B2, B4, B5, C1, C3, D3, E2 EFFECT OF TEMPERATURE, SOLIDS CONTENT AND PH ON THE SURVIVAL OF SALMONELLAS IN CATTLE SLURRY

Institute for Research on Animal Diseases, Compton, Newbury, Berkshire, England
P.W. Jones
British Veterinary Journal, V. 132, No. 3, p. 284-293, 1976. 4 fig., 4 tab., 13 ref.

Keywords: Slurries, Cattle wastes, Waste storage, Temperature, Solids, pH, Salmonella

Work was done to study the effect of altering storage conditions on survival of salmonellas in slurry and to study conditions which may lead to the decline or multiplication of these organisms. It was found that survival of salmonellas in cattle slurry was influenced by the number of organisms originally introduced, storage temperature, slurry solids content, solids content and temperatures below 10°C. During storage, the decline in pH may reflect the production of acidic compounds toxic to salmonellas. A significant reduction in salmonella concentration will result if slurry is stored for at least one month prior to land spreading. If pastures receiving such slurry are withheld from grazing for a month, risk of spreading *S. dublin* via slurry will be greatly reduced. This period may have to be extended when strains suspected of having an extended survival time in slurry or strains thought to have a lower infective dose, such as *S. typhimurium* are suspected of being present. (Merryman-East Central)

5700-A11, C1, C2 EFFECT OF DIETARY MINERAL LEVELS AND FEEDING MOLASSES ON THE INCIDENCE OF LOOSE DROPPINGS IN CHICKENS

Animal Nutrition Division, National Institute of Animal Industry, Tokyo, Japan
S. Hijikuro

Journal of Agricultural Research Quarterly, V. 11, No. 2, p. 120-123, 1977. 2 fig., 2 tab., 6 ref.

Keywords: Poultry wastes, Moisture content, Sodium, Potassium, Magnesium, Performance, Molasses

A study was conducted to determine what caused loose poultry droppings from the

standpoint of dietary composition with the aim of preventing them. The effect of deficiency or excess of sodium (Na), addition of potassium (K), or magnesium (Mg) to the conventional ration, and the feeding of molasses on water consumption of chickens, and moisture content of feces was discussed. Experiments with high-Na and high-K diets showed that excessive supply of Na, K, or both caused significant increases in water consumption, urine excretion and fecal moisture as compared to those with the standard feed. Moisture content of feces also increased significantly by the excess of Na or K reaching 80% at the maximum. The addition of K_2SO_4 or supplemental molasses increased water consumption with a proportional increase in moisture content of the droppings. The large amount of potassium was responsible for the occurrence of loose droppings. In addition to the potassium, it was considered that the molasses might contain some unidentified substances which caused this problem. Further investigation is needed on this aspect. (Little-East Central)

5701-A11, B2, B5, E2 COMPARISON OF LIQUID MANURE SLURRY AND NITROGEN FERTILIZATION ON ORCHARD-GRASS PASTURE FOR DAIRY HEIFERS

University of Tennessee, Knoxville, Tennessee
M.J. Montgomery, B.J. Bearden and J.W. High, Jr.
Journal of Dairy Science, V. 58, N. 1, p. 148, 1975.

Keywords: Slurries, Nitrogen, Fertilizers, Pastures, Forage management, Land application, Performance

Ten paddocks (.81 ha each) of Boone orchardgrass were fertilized with: (1) 56 kg of nitrogen/hectare in three split applications (four paddocks); (2) equivalent amount of nitrogen/hectare from liquid manure slurry (three paddocks). Holstein heifers were used at a stocking rate of three animals (330 kg)/hectare in 1973 and 3.3 animals (217 kg)/hectare in 1974. Salt, minerals, and water were provided all animals. Average daily gain (kg) and total carrying capacity (animals/hectare) were .81, 627; .82, 518; and .80, 617 for the three treatments for 1973. Similar data for 1974 were .65, 624; .65, 572; and .71, 674. These data indicate that with excellent forage management large amounts of liquid manure slurry can be applied to pastures with no detrimental effect on gain or carrying capacity. (J. Montgomery-University of Tennessee)

5702-A7, A11, B1, C2 RESPONSE OF CALVES TO ATMOSPHERIC HYDROGEN SULFIDE AND AMMONIA

Department of Agricultural Engineering, University of Alberta, Edmonton, Alberta
G.A. Nordstrom and J.B. McQuitty
Paper No 75-212, Canadian Society of Agricultural Engineers, 1975 Annual Meeting, Brandon University, June 22-26, 1975, 25 p. 6 fig., 7 tab., 19 ref.

Keywords: Animal health, Cattle, Hydrogen sulfide, Ammonia, Air pollution, Performance

Thirty-six steer calves averaging 400 lb. liveweight were exposed in a replicated experiment to three levels of hydrogen sulfide and of ammonia in enclosed chambers for a continuous period of seven days. Calf response to the effects of the gases both alone and in various combinations were studied at background (<20), 65 and 150 ppm levels of NH_3 and at 0, 20, and 150 ppm levels of H_2S . Feed and water consumption, respiratory rate, rectal temperature, and body weight were used as assessment parameters. Data also were collected for seven day pre-exposure and post-exposure periods to permit analysis among as well as within periods. Clinical and gross pathological examinations of the calves were included in the study. (Nordstrom-University of Alberta) (CSAE)

5703-B2, C3, D3, E3 ENHANCED ENERGY PRODUCTION AND WATER REUSE FOR SWINE OPERATION IN HAWAII

Department of Agricultural Engineering, University of Hawaii at Manoa, Honolulu, Hawaii
P.Y. Yang, C.J. Huang, and H.M. Gittlin
Paper No 79-4063, American Society of Agricultural Engineers and Canadian Society of Agricultural Engineers, 1979 Summer Meeting, University of Manitoba, June 24-27, 1979, 18 p. 11 fig.

Keywords: Recycling, Digesters, Anaerobic, Design, Swine wastes, Liquid wastes, Methane, Algae, Wastewater reuse, Lagoons

Enhancement of bio-gas production by enrichment of algae grown from anaerobic digestion of swine manure is feasible. An addition of 30% algal TVS in the feed will increase gas yield by 17% compared to the conventional anaerobic digestion process without algal addition. Concentration of NH_3-N of 80-100 mg/l will provide the maximum specific growth rate of algal growth which can be further digested to methane gas. (Yang-University of Hawaii)

5704-A6, C2, C3, D3, E3, F1 CORNELL DEVELOPS METHANE PRODUCTION SYSTEM

Anonymous
Livestock, V. 57, No. 7, p. 32-33, 1979. 1 fig.

Keywords: Methane, Cattle wastes, Odor, Anaerobic, Fermentation, Digesters, Phosphorus, Potassium, Economics, Animal wastes, Nitrogen, Ammonia

Cornell University has developed a full-scale demonstration facility designed to produce methane from cow manure. The process removes 90% of the odor from the waste material being treated. The Cornell digester produces about 2,000 cubic feet of methane a day. That's about \$8 worth of energy based on the current price of propane gas, or about \$2,200 worth of fuel a year. Part of the gas is used to keep the digester operating at a 95° temperature. At this temperature, methane-forming bacteria thrive in the absence

of oxygen. Because this bacterial process (called anaerobic fermentation) stops when the digester cools down to 50°, about 30% of the gas being generated is used to keep the digester warm and working. The farmer ends up having \$1,000 to \$1,500 worth of net energy a year. Besides energy production, the system alleviates the problem of animal waste pollution. The digester, while yielding methane, turns the waste into an almost odorless material yet preserves such nutrients as nitrogen in ammonia form, phosphorus and potassium. (Little-East Central)

5705-A11, B3, C2, E3 DEHYDRATED POULTRY EXCRETA VS COTTONSEED MEAL AS NITROGEN SUPPLEMENTS FOR HOLSTEIN STEERS

U.S. Department of Agriculture, Beltsville, MD 20705
L.W. Smith, C.C. Calvert and H.R. Cross
Journal of Animal Science, V. 48, No. 3, p. 633-640, 1979. 5 tab., 23 ref.

Keywords: Refeeding, Poultry wastes-dried, Sheep, Cattle, Performance, Meat quality

Pelleted diets of corn meal supplemented with dehydrated caged layer excreta (DPE) were consumed by wethers and Holstein steers as readily as diets supplemented with cottonseed meal (CSM). In addition to the pelleted diets fed *ad libitum*, steers were fed .50 kg of mature orchardgrass hay daily. Digestibilities of organic matter (mean, 84.4%) and nitrogen (mean 70.8%) determined with wethers did not differ for the two concentrate diets. Nitrogen utilization did not differ for the two diets. Ruminal fluids from steers fed the DPE diet contained more ammonia ($P<.01$) and acetic ($P<.01$) and butyric acids ($P<.05$), but less propionic ($P<.01$) and valeric ($P<.01$) acids than steers fed the CSM diet. Over the entire 414-day feeding trial, steers fed the CSM diet gained 5% faster ($P>.10$) on 8% less feed ($P<.10$) than steers fed DPE diet. Feed cost/kilogram gain was 7.6% lower for steers fed the DPE diet, but the extra days on feed to achieve equal market weight reduced the economic advantage to only 1.6% over the CSM diet. Source of nitrogen did not cause performance evaluated at 100-kg intervals to differ between 200- and 500-kg live body weights. Steers fed the CSM diet were heavier ($P<.01$) at slaughter and yielded heavier chilled carcasses ($P<.05$) that contained a lower percentage of trimmed red meat than steers fed the DPE diet. Dressing percentage, tenderness, juiciness, quantity of connective tissue, flavor and overall quality rating of beef did not differ for the two diets. (Smith-Ueda)

5706-A2, A4, C2 BIOTA OF FEEDLOT WATER-SHED PONDS

R.D. Applegate, G.L. Rolfe, and L.E. Arnold
Project 55-345, Illinois Agricultural Experiment Station, January, 1978, p. 246-247.

Keywords: Ponds, Cattle wastes, Water-sheds, Type/s, Feedlot, Biota, Sampling, Substrates, Temperature, Plankton, Larvae

Two ponds located near the feedlot water quality study area were sampled in May, 1977

to establish biological baseline data. The woodland pond was located below in dry site oak-hickory woodlot; the grassland pond was located at the base of a tall fescue field. The objectives were to establish baseline data on plankton, benthos and other biota on which to base other data collections after livestock waste has been incorporated onto the watersheds. Seine hauls were made across shallow sections of the ponds. Plankton samples were taken with a standard plankton net and 1.5 ml sample bottle. A Ponar dredge was used to collect bottom samples. All samples were returned to the laboratory in Urbana for analyses. Cattail stands were measured with a steel tape. Sampling difficulties precluded the collection of more quantitative samples. It was not possible to effectively sample for fish without the use of an electric shocker. Factors which influenced the observations were: (1) difference in water temperature between ponds, (2) difference in pond substrates, and (3) the level of organic waste that had previously entered the pond. It was unknown why *Typha* depths and stand sizes varied so greatly between the ponds. The data indicated that Chironomid larvae were more abundant in the softer substrate of the grassland pond. The planktonic rotifers and cladocera were much lower in the grassland pond than in the woodland pond. (Applegate; Little, ed.)

5707-A11, B2, C2, C3, D3, E2, E3 HYDRAULIC SWINE MANURE HANDLING AT I.S.U.: REVIEW OF 15 YEARS OF EXPERIENCE

College of Agriculture, Iowa State University, Ames, Iowa 50011
R.J. Smith and T.E. Hazen
Journal Paper J-8400, Project 2126, Iowa Agricultural and Home Economics Experiment Station, 1976, 1 p. 27 ref.

Keywords: Swine wastes, Waste management, Confinement pens, Lagoons, Anaerobic treatment, Animal health, Nitrogen, Waste-water reuse, Flushing, Land application

This paper describes the evolution of a hydraulic swine manure handling system at Unit K, a 700-head swine confinement building at Iowa State University. Management has evolved from scraping into 2 open channels to implementation of the following in progressive order: (1) flushing into an anaerobic lagoon, (2) recycling lagoon water through an oxidation ditch and back to the facility, (3) flushing directly into the oxidation ditch, and (4) use of a rotating biological contactor. In 1970, the researchers decided to abandon as many mechanical devices as possible. Anaerobic-lagoon liquor was recycled directly back to Unit K, and mechanical-flush tanks were replaced by siphon units. Concurrent studies on land application of anaerobic lagoon liquor to corn were implemented. It was found that the effluent could be applied to corn during its growing stage, except for 6 weeks after germination. The effluent replaced all chemical fertilizer (NPK), and, if nitrogen was limited to 250 kgN/ha annually, then no measurable environmental pollution resulted. While the researchers believe the open channel, manure-handling system described has merit, disadvantages which they list include a potential disease transmission hazard and the loss of 75% of fecal nitrogen from such lagoons by volatilization. (Merryman-East Central)

5708-B3, B4, D1, D3, E3, F1 COSTS FOR HARVESTING CORN STOVER AND PRODUCING EX- CRETA-STOVER SILAGE

Iowa State University of Science and Technology, Agriculture and Home Economics Experiment Station, Cooperative Extension Service, Ames, Iowa.

R.L. Vetter, W. Burroughs, and R.J. Smith
A.S. Leaflet R239, Iowa State University of Science and Technology, Agriculture and Home Economics Experiment Station, Cooperative Extension Service, July, 1976, 4 p. 3 tab.

Keywords: Refeeding, Silages, Animal wastes, Crop residues, Economics, Waste storage

Research on harvesting and feeding crop residues was conducted. Recent research demonstrated the potential feeding value of excreta-stover silage. Data were compiled, along with the use of standard equipment charges, to estimate the cost of producing excreta-stover silage using two methods of corn residue harvest. For an automated bunk feeding system the cost was calculated at \$2.65 versus \$3.09 for silage feeding. The costs for complete excreta-stover silage using stack harvested stover ranged from \$8.75 to \$16.05 per ton as fed. Costs can be calculated for the corn residue portions only to compare harvesting, handling and storage costs. Maintenance cost via corn silage feeding would be 12 to 14 pounds DM x 3.3 cents = 40 to 46 cents per day. The excreta-stover silage provided protein and mineral needs. Indiscriminate use of either stover silage or excreta-stover silage may prove costly in over-all beef production. Machinery cost estimates were: (1) Economic life was taken as 7 years. (2) Most field machinery was assigned a salvage value of 50 percent of the purchase price. (3) The interest charged on loans was taken as 9 percent, and the annual interest cost was calculated on half the purchase price. (4) Annual taxes and insurance were assessed at 1.5 percent of the on-farm value. (5) Providing machinery shelter cost 1 percent of the purchase price annually. (6) Fuel was charged \$0.40 per gallon after tax credit. (7) Labor costs were taken at \$4 per hour. (8) All tractors had an annual use of 500 hours. (9) Repair and maintenance charges were calculated from cost information collected internally or at 1.6 percent of purchase price per 100 hours of operation if specific information was not available. (Little-East Central)

5709-A8, B1, B2, B4, E2, F1, F2 MANURE MANAGEMENT FOR ENVIRONMENTAL PROTECTION

Pennsylvania Department of Environmental Resources
Bureau of Water Quality Management Publication No. 43, Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania, 1977, 91 p. 13 fig., 10 tab., 106 ref.

Keywords: Waste management, Economics, Legal aspects, Storage, Slurries, Application techniques

The purpose of this manual is to describe for the Pennsylvania agricultural community, the environmental protection requirements of the Department of Environmental Resources (DER) and also to describe for the DER personnel normal farming operations. The practices described in the manual consider not

only environmental protection but also how the practice fits into farming operations. The manual emphasizes prevention of pollution rather than elimination of pollution after it occurs. The manual provides a farmer with information that he can use to best manage manure. Included in the manual are topics dealing with: water pollution laws and regulations affecting farmers, indoor components of manure management systems, daily hauling, storage systems, guidelines/recommendations for earthen-bank storages, covered manure storages, and for slotted dams for separation of precipitation in open storages, rainfall data, field application of manure other than by irrigation, Pennsylvania soil series soil productivity groups, field application by irrigation, and processing alternatives. (Little-East Central)

5710-A6, A11, B1, C2, D3 PERFORMANCE AND ODOR EVALUATION OF FECES FROM PIGS FED AN ODOR SUPPRES- SANT

Michigan State University, Agricultural Experiment Station, East Lansing, Michigan
E.R. Miller and M.T. Yokoyama
Research Report 343, Report of Swine Research 1977, Michigan State University, Agricultural Experiment Station, September, 1977, p. 120-126. 7 tab.

Keywords: Feed additives, Odor control, Swine wastes, Performance, Swine, Confinement pens

The objective of this study was to determine the influence of feeding a commercial odor suppressant (OS)² to starting and growing pigs on weight gain, feed efficiency, diet component digestibility, nutrient balance and amelioration of fecal odor. Incorporation of OS in starter and grower diets at levels of 2 and 4% did not deleteriously affect feed intake, gain, or efficiency of feed utilization over the control. However, neither was there a stimulatory effect observed in these parameters as a result of OS supplementation. In an odor evaluation study, participants were asked to evaluate treatments both qualitatively as well as quantitatively. It appeared to be more difficult for them to assess odors quantitatively. This is a serious shortcoming of any subjective organoleptic evaluation, and can only be minimized by using pretrained participants and chemical analyses of actual concentrations of contributing odorous components of the feces. A definite qualitative change in odor was obvious as a result of OS incorporation into the diet. Investigators were able to duplicate *in vitro* the qualitative fecal odor change as a result of feeding OS directly to untreated swine wastes. (Little-East Central)

5711-C2, C3, D3, E3 PAUNCH RESIDUE SILAGE PRO- VIDES MAINTENANCE FEED

Anonymous
Feedstuffs, V. 51, No. 24, p. 19, June 11, 1979.

Keywords: Paunch manure, Refeeding, Ensilaging, pH

Paunch residue from slaughtered cattle was

ensiled with chopped hay and ground barley. When a small amount of malted barley was added to the silage, sheep ate as much dry matter per day from the paunch silage as from corn silage. The paunch silage was low in digestibility and was suitable only for maintenance rations. Ensilage eliminated the cost of dehydration and destroyed potential pathogens of disease. The paunch residue without hay or other additive was too high in pH. Treatments with paunch residue, hay, 100 g barley, 10 g malt extract or 10 g malt extract and 20 ml *Lactobacillus plantarum* had the lowest pH at day 3 and 10 and appeared to be the most promising treatments. (Little-East Central)

5712-A6, B2, C1, D2, D3, F1 PRODUCTS FOR CONTROL OF HOG WASTE ODORS

D.J. Warburton, J.N. Scarborough, D.L. Day, and A.J. Muehling
Illinois Research, V. 21, No. 2, p. 7, Spring, 1979

Keywords: Odor control, Swine wastes, Digestive agents, Deodorants, Oxidizing agents, Disinfectants, Economics, Chlorine, Aeration, Liquefaction, Waste treatment

A study was conducted at the University of Illinois to determine how effectively odor-control compounds reduced odors and liquefied solids in liquid manure pits under swine finishing buildings. Twenty two commercial compounds which fell into the following categories were included in the experiment: (1) Digestive agents, (2) Deodorants, (3) Oxidizing agents, and (4) Disinfectants. Six other treatments were also tested: waste oil, activated charcoal, wintergreen oil, chlorine, mechanical aeration, and an experimental product formulated at the University of Illinois. The overall performance of the commercial compounds in reducing odors was disappointing. Chlorine and the University experimental product reduced odors most effectively. Solids breakdown was not greatly improved by any of the compounds. Swine Aid, chlorine and the University product were the most effective materials for controlling surface crusting. It was found that chlorine and the experimental product were too expensive for general use. Mechanical aeration was the most effective treatment of all. (Little-East Central)

5713-D2, E3 BIOMASS GASIFICATION PRO- CESS DEVELOPMENT UNIT

Garrett Energy Research & Engineering Co.,
911 Bryant Place, Ojai, California 93023
D.E. Garrett
Seventh Biomass Thermoconversion Contractors' Meeting, Roanoke, Virginia, April 24-25, 1979, 6 p. 1 fig.

Keywords: Waste treatment, Recycling, Pyrolysis, Combustion, Biogas, Dehydration, Design

The GERE PDU was revamped and reconstructed. During the next quarter it will be run using manure as the feed. In addition to exploring the operational parameters of the process, an endurance test will also be performed. (Mikeell-Garrett Energy Research & Engineering Co., Inc.)

5714-B3, C1, D2, E3, E4 THE GARRETT ENERGY RE- SEARCH BIOMASS GASIFICA- TION PROCESS

Garrett Energy Research & Engineering Co.,
Inc., 911 Bryant Place, Ojai, California 93023
R.D. Mikeell, D.C. Hoang, and D.E. Garrett
Unpublished Paper, 20 p. 2 fig., 5 tab., 5 ref.

Keywords: Waste treatment, Design, Dehydration, Pyrolysis, Combustion, Biogas, Recycling, Cattle wastes, Equipment-gasification, Mathematical models

A multiple hearth furnace is used for the gasification of biomass materials. Drying, pyrolysis, steam/char gasification, and combustion steps are carried out, each on its own hearth. Partially dry biomass feed is contacted on the top hearth of the furnace with hot flue gas from the combustion stage. The steam contained in the flue gas leaving the top hearth is condensed in the jacket of a vacuum pre-dryer. The nearly dry feed material on the top hearth is dropped into the pyrolysis hearth where it is pyrolyzed in the absence of oxygen at about 750°C. The pyrolysis gas is passed through a condenser which removes the steam and tar. Some of the pyrolytic carbon is steam-gasified at about 850°C in an external lift tube, while the remainder is burned on the combustion hearth. The ash drops onto the ash cooling hearth where it exchanges heat with the incoming combustion air. (Mikeell-Garrett Energy Research & Engineering Co., Inc.)

5715-A2, A8, B2, C1, E2 PHOSPHORUS TRANSPORT IN SURFACE RUN-OFF AS INFLU- ENCED BY FERTILISER AND GRAZING CATTLE

Department of Soil Science, Massey Univer-
sity, Palmerston North, New Zealand
A.N. Sharpley and J.K. Syers
New Zealand Journal of Science, V. 19, p.
277-282, 1976. 2 fig., 5 tab., 26 ref.

Keywords: Phosphorus, Surface runoff, Rain-
fall, Fertilizer, Cattle, Sampling, Land appli-
cation

The effects of fertiliser and grazing cattle on the transport of phosphorus in surface run-off were evaluated using field plots and natural rainfall. During 4 months, the proportions of forms of P lost in surface run-off from one fertiliser application (50 kg P ha⁻¹) to a 13° undrained slope amounted to 2.9, 3.2, and 6.7% as dissolved inorganic P (DIP), total dissolved P (TDP), and total P (TP), respectively. Slightly lower amounts of fertiliser P were lost from a 6° undrained slope, and a much lower proportion was lost from a 8° drained slope (0.60, 0.70, and 1.00% as DIP, TDP, and TP, respectively). This may be attributed to a 4-fold reduction in the volume of surface run-off and to the lower mean dissolved and particulate P concentrations in surface run-off from the drained plot. Losses of P resulting from 1 grazing by dairy cattle amounted to 0.16, 0.46, and 0.77 kg P ha⁻¹ as DIP, TDP, and TP, respectively, in the ensuing 4 weeks. The forms of P in runoff which were most affected by grazing animals were dissolved organic P(DOP) and total particulate P(TPP). Fertiliser application had a more sustained effect on DIP and TPP losses than grazing animals. Forty days after fertiliser application, the loss of DIP was only twice that from the control, whereas that of TPP was 5 times greater than that from the control. The sustained effect of fertiliser

addition on the transport of TPP is discussed along with the relative importance of fertiliser and grazing cattle in the transport of P forms in surface run-off. (Sharpley-Massey University)

5716-B1, B2, C3, D1, D2, D3, E3, E4 METHANE PRODUCTION FROM BEEF CATTLE FEEDLOTS

Hamilton Standard, Division of United Tech-
nologies Corporation
D.J. Lizard
Second Annual Fuels from Biomass Symposi-
um, Renaissance Polytechnic Institute, Troy,
New York, June 20-22, 1978, 21 p. 12 fig.

Keywords: Methane, Waste treatment, Cattle
wastes, Feedlots, Effluent, Anaerobic, Fer-
mentation, Recycling, Refeeding, Design,
Dehydration

The residues from beef cattle in feedlots provide an easily collectible source of biomass that can be converted to fuel gas and other useful products. This paper describes and presents the status of two programs being conducted by Hamilton Standard, Division of United Technologies Corporation under contract to the U.S. Department of Energy. The first program is a pilot scale evaluation to determine the feasibility of producing methane and a cattle refeed product from dirt feedlot residues using anaerobic fermentation. The second is for design, construction and operation of a full scale anaerobic fermentation facility to identify the technical and economic viability of producing fuel gas and a refeed product from the residues from an environmental beef cattle feedlot. (Lizard-Hamilton-Standard)

5717-A9, A11, C3 THE INFLUENCE OF ANTIM- ICROBIAL AGENTS ON THE PERCENTAGE OF TETRACYC- LINE-RESISTANT BACTERIA IN FAECES OF HUMANS AND ANIMALS

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lege of Veterinary Medicine, University of
Missouri-Columbia, Columbia, Missouri
65201
J.G. Ahart, G.C. Burton, and D.C. Blenden
Journal of Applied Bacteriology, V. 44, p.
183-190, 1978. 1 tab., 20 ref.

Keywords: Antibiotics, Bacteria, Tetracyc-
line, Animal wastes, Human wastes

A study was conducted to examine the influence of various antimicrobial agents upon the percentage of tetracycline-resistant facultative and obligate anaerobic bacteria in the intestines of humans and animals. Tetracycline resistance was chosen because (a) the tetracyclines are frequently used in both human and animal medicine, (b) tetracycline is the most common antibiotic to which enteric organisms are resistant. At least 2 fecal specimens were collected from each person, calf, pig, horse, dog and cat included in this study. Samples from persons or animals

receiving antibiotics were collected at least 4 days after therapy had begun. The second sample was collected 2-5 days after the first. Subjects included in control groups had received no antimicrobial agent within the past two months. The majority of humans and animals included in this study harboured tetracycline-resistant bacteria. More than half (58%) of human subjects not receiving antibiotics possessed tetracycline-resistant anaerobes and all possessed tetracycline-resistant anaerobes. This and other studies seem to indicate that the problem of emerging resistance due to antimicrobial agents is even greater than that already presumed. If antimicrobial resistance persists in obligate anaerobes over a period of time despite withdrawal of some antimicrobial agents, then the pool of resistant anaerobes is increasing more rapidly than the pool of facultative organisms. (Merryman-East Central)

5718-A6, B3, C1, C2, D3, E3, F1 ENSILING CATTLE WASTE AND HAY TREATED WITH ALKALI

W.D. Lamm, K.E. Webb, Jr., G.R. Dana, and J.P. Fontenot
Livestock Research Report, Research Division
Report 172, Virginia Polytechnic Institute and
State University, July, 1977, p. 43-45, 2 tab.

Keywords: Cattle wastes, Ensiling, Chemical treatment, Sodium hydroxide, Dry matter digestibility, pH, Odor, Waste composition, Economics

A laboratory study was conducted to determine the ensiling characteristics and *in vitro* dry matter digestibility of cattle waste and ground hay treated with different levels of sodium hydroxide (alkali). Fresh cattle waste (77% moisture) was collected from a concrete slab during a 4-hour period from pens with cattle fed a 70% concentrate diet. The waste was mixed with legume-grass hay (11% moisture) which had been ground through a hammermill with a 1-inch screen. The proportions were 60% waste and 40% hay, fresh basis. Sodium hydroxide flakes were added to the mixture at levels of 0, 2, 4, 8 and 12%, dry basis. After a 33-day ensiling period, the silos were weighed and samples of the ensiled mixtures were obtained for determination of dry matter, lactic acid, pH, *in vitro* dry matter digestibility (IVDMD) and volatile fatty acids. Dry matter content of the control silage with no alkali treatment was 50.5% and increased gradually with alkali additions. pH values increased in the initial and ensiled mixtures with increasing additions of alkali also. The 4, 8, and 12% alkali additions resulted in high pH values of 7.2, 9.6, and 11.3, respectively, and relatively low lactic acid levels at the end of the ensiling period. *In vitro* dry matter digestibility was enhanced by the ensiling process. Dry matter loss for all ensiled mixtures was less than 1%. The control and 2% alkali mixtures smelled like good quality haylage. The 8 and 12% alkali levels had a "soapy" smell, and frequently, a strong ammonia smell. Further studies are being conducted to determine the replacement value of this 60:40 mixture when treated with alkali for good quality corn silage in rations for growing beef calves. Additional studies will determine the value of ensiled cattle feces and crop residues with or without chemical treatment as winter feed for gestating-lactating beef cows. (Merryman-East Central)

5719-A11, A12, C2, D3, E3, F2 EVALUATION OF SINGLE CELL PROTEINS FOR NONRUMINANTS

Department of Health, Education and Welfare
J.C. Taylor, E.W. Lucas, D.A. Gable, and G. Graber
International Symposium on Single Cell Protein-Standardization, Evaluation and Safety, Rome, Italy, Nov. 7-9, 1973, 10 p. 2 ref.

Keywords: Refeeding, Single cell protein, Safety, Animal health, Public health, Legal aspects, Fermentation, Carcass quality

Any ingredient used in the diet of animals is subject to provisions of the Federal Food, Drug and Cosmetic Act. A food is deemed adulterated if it contains any poisonous or deleterious substance which may render it injurious to health, if it contains any food additive which is unsafe, or if it consists in whole or in part of any filthy, putrid or decomposed substance. The term "food additive" means any substance which may become a component of food and is not generally recognized as safe among experts qualified by scientific training and experience to evaluate its safety. This publication directs its discussion toward evaluation of single cell proteins for nonruminants. The factors involved in the production of a single cell protein make such evaluation a complex problem. These factors are: (1) source of substrate, (2) fermentation process, (3) preparation for feeding to animals, (4) consumption by animals, and (5) consumption of animals by man. The three basic categories of concern are: (1) establishing nutritive value, (2) determining safety to animals, and (3) determining that food derived from animals consuming such products are safe for man. The latter is accomplished by: (1) determining if tissue residues exist, and (2) if tissue residues do exist, determining if they are safe. The basic toxicology studies to evaluate human safety include two year studies in a rodent; one to two year studies in the dog, and three generation reproductive studies. Utility of the product as primarily a protein source and secondarily as an energy source may be demonstrated adequately for some species by determination of the protein efficiency ration (PER) and metabolizable energy (ME) value. Determinations of vitamin content, trace mineral content, amino acid composition, etc., as well as their availability to the animal, may also be considered as supportive evidence of utility. Manufacturing, chemistry, and quality control data are also essential in evaluating SCP products. A complete description of the raw material, the manufacturing process, and the finished product should be provided. (Merryman-East Central)

5720-A10, B3, D2, E3 SWINE WASTE RECYCLING VIA CARP PRODUCTION IN WEST- ERN OREGON PONDS

Oregon State University, Corvallis, Oregon
P.R. Cheeke, C.E. Bond, P.B. George, and D.C. England
Proceedings, Western Section, American Society of Animal Science, V. 38, p. 97-98, 1977, 3 tab., 3 ref.

Keywords: Swine wastes, Recycling, Fish, Ponds, Performance, Refeeding, Autoclaving, Crude protein

Carp were grown in experimental ponds fertilized with swine manure, with the objective of recycling the swine waste to produce a high quality protein supplement (fish meal). Although high rates of gain per fish were obtained, total yield/ha was low. This may reflect the low stocking rate used, or may reflect the true carrying capacity of fish ponds under Western Oregon conditions. Further studies are needed to determine which of these is the case. A protein efficiency ratio (PER) experiment with rats showed that carp meal (raw or autoclaved) compared favorably with other common protein supplements. (Cheeke-Oregon State University)

5721-A11, B1, C2 THE EFFECT OF DIURETICS ON THE FAECAL EXCRETION OF WATER AND ELECTROLYTES IN HORSES

Department of Veterinary Pharmacology,
Royal (Dick) School of Veterinary Studies,
Summerhall, Edinburgh EH 9 1QH, Scotland
F. Alexander
British Journal of Pharmacology, V. 60, p.
589-593, 1977, 6 fig., 13 ref.

Keywords: Feed additives, Diuretics, Horse wastes, Frusemide, Hydrochlorothiazide, Electrolytes

Four male, shetland-type ponies, weight 180 kg - were fed hay (2.5 kg/day) without concentrates except when markers were given. Markers used were chromium oxide (10g) and polyethylene glycol (200g) which were thoroughly mixed in about 500 g of bran and oats and fed to the ponies. Frusemide and hydrochlorothiazide were given by injection into the jugular vein. The effect of plasma, urinary and faecal electrolytes of frusemide and hydrochlorothiazide was measured in the ponies. Rapid loss in urine of large quantities of sodium had only a small effect on plasma sodium concentration. Faecal sodium excretion was increased substantially after the administration of frusemide. Frusemide increased faecal potassium during the 48 h following administration and faecal water in the 24/48 h period. It also produced a hypotassaemia. Hydrochlorothiazide increased faecal chloride during the 24 hours after administration. Frusemide increased the intestinal transit time of both liquid (polyethylene glycol) and particulate Cr_2O_3 markers. (Merryman-East Central)

5722-B2, B3, D1, D3, E2, E3, F1 POULTRY MANURE -- CAN NEW TECHNOLOGY INCREASE PRO- FITS?

Department of Agricultural Engineering,
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68583
D.D. Schulte
Paper presented at 1978 Fact Finding Conference of the Poultry and Egg Institute of America, Houston, Texas, Sept. 14, 1978, 20 p. 2 tab., 31 ref.

Keywords: Poultry wastes, Recycling, Methane, Refeeding, Fertilizers, Land application, Dehydration, Aerobic treatment, Anaerobic treatment, Ensiling, Single-cell-protein, Soil injection, Economics

This paper highlights recent developments in

utilization of poultry manure and indicates, where possible, the economic implications of such developments. The following are considered: (1) methane generation, (2) refeeding, and (3) use as fertilizer. Methane generation cannot, at this time, be recommended for many poultry producers. Operations where methane generation is economically feasible will be characterized by: (1) high costs of fuel or electricity such as currently is the case in the Northeast portion of the U.S.; (2) a year-round, integrated system of energy demands; (3) a manure handling system that is compatible with the feeding requirements of an anaerobic digester; (4) a level of management capable of understanding and controlling digester performance; (5) adequate land resources capable of handling the extra volume of liquid necessitated by dilution to control ammonia inhibition; (6) large-scale size necessary to obtain economies of scale involved in capital cost of construction. For refeeding, prior treatment of the wastes may be desirable. Dehydration, ensiling, aerobic, and anaerobic treatment are considered. Single-cell-protein production from animal manure via a number of process including algae, housefly larvae, thermophilic aerobic digestion, mushrooms and yeast is also considered. For fertilizer use, liquid injection systems, plowdown of solid wastes, and sale of processed poultry wastes are considered. (Merryman-East Central)

5723-A6, B4, C1, C2, D2 EFFECT OF RATION, WASTE COMPOSITION AND LENGTH OF STORAGE ON THE VOLATILIZATION OF AMMONIA, HYDROGEN SULFIDE AND ODORS FROM CATTLE WASTE

Oregon State University, Corvallis, Oregon 97331
R.O. Kellems, J.R. Miner, and D.C. Church
Journal of Animal Science, V. 48, No. 3, p. 436-445, March, 1979. 2 fig., 10 tab., 19 ref.

Keywords: Cattle wastes, Ammonia, Hydrogen sulfide, Dry matter, Crude protein, Urea, pH, Odor control, Feed additives, Waste composition, Storage, Volatilization, Sagebrush, Peppermint oil

Several variables associated with the composition and management of bovine waste and various grains (corn, milo, barley) and their level of supplementation (25%, 50%, 75%) in rations were evaluated to determine their effect on initial volatilization of ammonia (NH_3), amines, hydrogen sulfide (H_2S), and odoriferous compounds. Dry matter (DM) and crude protein (CP) content of feces were not correlated ($P > .10$) with initial NH_3 volatilization. Urea content and specific gravity of urine were positively correlated ($P < .10$) with the NH_3 initial evolution rate. The grain source altered the pH of waste ($P < .05$) with milo producing the lowest pH and barley the highest. NH_3 volatilization showed a positive correlation ($P < .05$) with pH of waste. Urea from urine was the primary precursor of the initial NH_3 volatilized with maximum release of NH_3 occurring between the second and fifth day of storage. Volatile amines accounted for approximately .11% of the total nitrogen volatilized and were positively correlated ($P < .01$) with NH_3 evolution. Addition of sagebrush at 1% and 1.5% levels showed no modification ($P > .10$) of olfactory evaluation of the waste. Peppermint oil at the .25% level in the diet reduced

($P < .05$) the relative offensiveness associated with the waste. (Kellems-Oregon State University)

5724-A11, B3, C1, C2, D3, E3, F1 LET THEM EAT WASTE?

Editor, Feedlot Management
G. Ashfield
Feedlot Management, V. 20, No. 4, p. 14-16, April, 1979. 2 fig.

Keywords: Refeeding, Cattle wastes, Ensilage, Economics, Cattle, Performance

Cattle feeders are showing an interest in waste refeeding because of expected increases in feed costs and the continuing problems of waste disposal. They want to find out if recycling of cattle manure can reduce cost of gain and lessen waste disposal. The nutritive value of manure depends upon its chemical composition, digestibility of its nutrients and the palatability of the ration in which the waste is incorporated. The value of refeeding is discussed. During an ensiled animal waste feeding program, the feed is stored in a silo before feeding. In the silo, the product goes through a lactic acid fermentation which changes the chemical and physical nature of the product, especially the manure. Thus, the ensiling process is an effective mechanism of eliminating the potential for disease transmission through refeeding of manure. Protein supplemented growing rations are a good way to use manure as a fattening ration for cattle. However, there are definite limits to the amount of manure a ration and animal can stand. (Little-East Central)

5725-A2, B2, F2 RUNOFF CONTROL SYSTEMS FOR OPEN SWINE FACILITIES

Department of Agricultural Engineering,
College of Agriculture, University of Illinois at
Urbana-Champaign, Urbana-Champaign, Illinois
D.H. Vanderholm and E.C. Dickey
Soil and Water Conservation, No. 15, Nov., 1977, 6 p. 6 fig., 1 tab.

Keywords: Feedlot runoff, Legal aspects, Runoff control, Swine wastes

Illinois Livestock Waste Regulations are scheduled to go into effect sometime during the winter of 1977-78 which will require new and existing feedlots to be in compliance with the regulations within 14 months after the effective date. In all open feedlots, control will be required of surface water runoff so that it will not cause water pollution. This control may be accomplished by clean water diversion runoff collection, settling basins, holding ponds, and pumping equipment. Runoff control should be carefully planned. Planning assistance for runoff-control systems can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service. For larger systems and detailed planning work, the services of a private consulting engineer are needed. (Merryman-East Central)

5726-A11, C1, C2, E3 NUTRITIONAL POTENTIAL OF CATTLE FEEDLOT WASTES

Fort Valley State College, Fort Valley, Georgia
W.L. Braman
Journal of Animal Science, V. 41, p. 239-240, 1975.

Keywords: Recycling, Cattle wastes, Feedlot wastes, Diets, Cattle, Waste composition

A laboratory study was initiated to estimate the nutritive value of feedlot wastes originating from cattle fed various types of diets. Cattle feedlot waste samples were collected eight times during a period of 30 days from 12 pens with solid concrete floors (two pens/treatment). Cattle were fed either a high concentrate, low roughage diet (HC) or an all roughage diet (R). The concentrate source was corn fed either whole, cracked, or ground; and the roughage source was coastal bermudagrass hay fed either long, ground, or ground and pelleted. Cattle fed long hay were allowed access to pasture. Nutrient values observed for wastes from steers fed the HC diets fed whole, cracked, or ground were: DM, 35.6, 29.9, 30.7; crude protein, 15.5, 17.1, 14.8%; ash, 8.5, 9.6, 7.3%; ether extract, 2.8, 3.0, 2.8%; crude fiber, 16.9, 20.1, 16.8%; NFE, 56.3, 50.2, 58.3%; IVOMD, 43.0, 41.6, 46.2%; NDG, 38.1, 45.5, 38.2%; ADF, 38.1, 45.5, 38.2%, respectively. Values from steers fed the R diets fed long + pasture, ground or pelleted were: DM, 32.0, 25.2, 23.2%; crude protein, 10.1, 13.6, 13.6%; ash, 35.5, 14.6, 11.3%; ether extract, 1.2, 1.6, 1.6%; crude fiber, 18.2, 27.9, 29.8%; NFE, 37.0, 42.3, 43.7%; IVOMD, 13.9, 17.3, 21.0%; NDF, 71.8, 67.0, 76.2%; and ADF, 51.1, 41.6, 44.2%, respectively. Processing had little effect on nutrient composition of wastes. However, all parameters measured except DM were affected by level of roughage fed. Apparently, feedlot wastes will have varying degrees of nutritional value for recycling depending upon the nature of the diet fed. (Braman-Fort Valley State College) (Abstract only)

5727-A8, B3, C2, E2 INFLUENCE OF MANURE APPLICATION RATES AND CONTINUOUS CORN ON SOIL-N

Department of Plant and Soil Science,
University of Vermont, Burlington, Vermont 05401
F. R. Magdoff
Agronomy Journal, V. 70, No. 4, p. 629-633, July-Aug., 1978. 2 tab., 18 ref.

Keywords: Land application, Crop response, Soils, Nitrogen

A comparison was made of the effect of manure on soil-N and crop response to inorganic-N between similar continuous corn experiments at two different sites. Site 1 was established as a continuous corn experiment on a somewhat poorly drained Panton clay in West Addison, Vermont in 1965. The field was planted to corn the year before the experiment began but had previously been in legume sod. Each spring 4 rates of manure (0, 22, 44, and 66 tons/ha) with a mean content of 0.32% N, wet weight and 5 rates of ammonium nitrate (0, 56, 112, 168, and 224 kg N/ha) were applied in a factorial arrangement. Manure was brought to the field from a neighboring farm and applied on the soil surface. Corn was grown from 1965 to 1970 and the soils sampled in the spring of 1968 and 1971. The initial N content of the 0-manure, 0-N plots at site 1 was 6,070 kg/ha 15 cm. Site 2 was established as a continuous corn experiment on a well drained Calais loam in Randolph, Vermont in

1970. The site, an old pasture, had been in corn production for 2 years before the experiment began. The basic plot design was the same as for site 1, except that only three rates of ammonium nitrate (0, 112, and 224 kg N/ha) were applied. Manure was brought to the site from a neighboring farm and applied as described for site 1. The mean N content of grab samples of the manure averaged 0.42% N (wet basis). The plots were treated as in site 1. Corn was grown from 1970 to 1975, and the soils were sampled in the spring of 1971 and 1976. The initial N content of the O-manure, O-N plots was 3,896 kg/ha 15 cm. Manure-N was less available to the growing crop on the clay and accumulated in the soil at a greater rate than in the loam. The annual manure application rates required to maintain initial soil N levels in Pantan clay and Calais loam under continuous corn production were calculated to be 40 to 52 tons/ha respectively. The ratio of manure mineralization rates calculated for the two sites was similar to the ratio of native soil organic matter rates. Thus, soils that have high rates of mineralization of soil organic matter in a given region may also mineralize organic matter from manure relatively rapidly. (Merryman-East Central)

5728-B2, B4, F1 INITIAL COSTS OF SETTING UP A SLURRY SYSTEM

Scottish Farm Buildings Investigation Unit
H.J. Wight
Farm Buildings Progress, V. 39, p. 13-18,
Jan., 1975. 4 fig., 4 tab., 5 ref.

Keywords: Waste management, Economics, Slurries, Waste storage

The initial cost of setting up a slurry system is isolated. It should be remembered that the initial cost is only one of many factors to be considered when setting up a slurry system. The influence of manurial value, labor requirements, initial costs, running costs, etc. must all be evaluated in producing a balanced system to suit an individual farm. Costs given in this article are based on what may be considered to be fairly typical county contractors' rates and are gross before the deduction of any grant. In planning a slurry system the amount of material to be handled must be estimated. Then removal, storage and ancillary facilities must be considered in terms of the particular farm being considered. Mechanically scraped systems and slatted systems are discussed. External storage is discussed in terms of above-ground silos, above-ground and below-ground concrete blockwork tanks, sleeper compounds and storage lagoons. Internal storage is discussed in terms of concrete blockwork channels below slats. Ancillary facilities are discussed in terms of slurry reception or pumping pit, vacuum tanker or slurry wagon and pump, and organic irrigation piping and equipment. The choice of slurry system will have an obvious effect on the building costs of any livestock unit, whether the building is constructed to suit the slurry system or the slurry system chosen to suit the building. Cost estimates are given in Scottish pounds. (Merryman-East Central)

5729- A5, A8, B1, C2 CROPPING AN ABANDONED

FEEDLOT TO PREVENT DEEP PERCOLATION OF NITRATE- NITROGEN

USDA, ARS, Route 1, Box 696, Cheyenne,
Wyoming 82001
C.E. Schuman and L.F. Elliott
Soil Science, V. 126, No. 4, p. 237-243, 1978. 6
fig., 4 tab., 6 ref.

Keywords: Abandoned feedlots, Feedlots,
Crop response, Groundwater pollution, Leach-
ing, Nitrates

This study was conducted to determine if deep-rooted plants, like alfalfa and corn, established on a feedlot immediately after abandonment, would remove sufficient amounts of NO₃-N to prevent its subsequent leaching into groundwater. Because the salt concentrations on the feedlot surface were high, 15 cm of material from half the plots was removed and replaced with field topsoil. The study revealed that when a feedlot is abandoned and planted to alfalfa, the crop will remove large amounts of nitrogen and prevent large accumulations of NO₃-N in the profile. Furthermore, removal of the surface material from the feedlot as soon as possible after abandonment, eliminated a large organic N source, which is readily convertible to NO₃⁻. For ease in management, alfalfa was found to be better than corn because it did not accumulate amounts of NO₃⁻ (which is toxic to livestock if fed directly). Alfalfa production was excellent from the abandoned feedlot, and alfalfa fits well into most general farm-management schemes. (Merryman-East Central)

5730-A4, A8, B2, B5, C2, D3, E2 RUNOFF WATER QUALITY AS AFFECTED BY SURFACE-AP- PLIED DAIRY CATTLE MANURE

USDA, Auburn, Alabama 36830
F.L. Long
Journal of Environmental Quality, V. 8, No. 2,
p. 215-218, April-June, 1979. 1 fig., 5 tab., 16
ref.

Keywords: Dairy wastes, Land application,
Nitrates, Biochemical oxygen demand, Chem-
ical oxygen demand, Agricultural runoff,
Potassium, Nitrogen, Phosphorus, Water pol-
lution

The effect of dairy cattle manure on runoff water quality was determined. The manure was surface-applied to Coastal bermudagrass (*Cynodon dactylon* (L.) Pers.) on a Norfolk sandy loam with 2% slope, at the rate of 45 metric tons/ha per year for 4 years in split applications. Manure applications slightly increased biochemical oxygen demand (BOD) values of runoff water; the maximum value was 20 mg/liter and annual mean values were all 10 mg/liter with no BOD buildup in the runoff water were increased by the manure, but all annual mean values were below critical levels at 8 mg NO₃⁻/liter. During the first 2 years, about 30 kg/ha total N was lost in runoff, but 6 kg N/ha was lost during the third and fourth years. (Long-USDA)

5731- A8, B2, C2, E2 RESIDUAL EFFECTS OF DAIRY CATTLE MANURE ON MILLET

AND RYE FORAGE AND SOIL PROPERTIES

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35752
L.M. Mugwira
Journal of Environmental Quality, V. 8, No. 2,
p. 251-255, April-June, 1979. 4 tab., 21 ref.

Keywords: Dairy wastes, Land application,
Micronutrients, Mineralization, Waste com-
position, Nitrogen, Phosphorus, Potassium,
Calcium, Magnesium, Sodium, Trace ele-
ments, Toxicity

Dairy cattle manure was applied to plots on Decatur silty clay loam (*Thermic Rhodic Paleudults*) in 1971, 1972, and 1973. The manure rates were 0, 22.5, 45, 90, 180, and 270 metric tons/ha (dry wt). Pearl millet (*Pennisetum americanum*, L.K. Schum) was grown in summer and clipped twice and 'Vrens Abruzzi' rye (*Secale cereale* L.) was grown in winter. The residual effects of the manure treatments on forage yields and mineral composition evaluated in 1974, 1975, and 1976 are reported in this study. The residuals of three annual applications of 180 and 270 metric tons/ha of manure were more effective than the lower rates in increasing millet and rye forage yields in 1974 to 1976 and total N and NO₃-N in 1974 and 1975. Phosphorus and, to some extent, Zn levels in millet were increased by the 22.5- and 45-metric ton rates, leveling or decreasing at higher manure rates. The manure residuals also increased the levels of K in 1974 and, generally, Mg in millet and K and Ca in rye and decreased Mn in millet and rye. Plant and soil data suggested that N limited plant growth in manure plots except at the 180- and 270-metric ton rates. At the higher rates there was significantly higher nitrate movement down the profile than the NPK check. The NO₃-N and total N levels in forage also suggested that N mineralization from three consecutive annual manure applications of 22.5 metric tons/ha was largely completed within the following 3 years. (Mugwira-Alabama A&M University)

5732-A5, A8, B2, C2, E2 NITRATE AND AMMONIUM CONCENTRATIONS OF GROUND WATER RESULTING FROM POU- LTRY MANURE APPLICATIONS

Department of Plant Science, University of
Delaware, Newark, Delaware 19711
W.C. Liebhardt, C. Golt, and J. Tupin
Journal of Environmental Quality, V. 8, No.
2, p. 211-215, April-June, 1979. 2 fig., 4 tab.,
18 ref.

Keywords: Groundwater pollution, Public
health, Land application, Poultry, Leaching,
Nitrate, Ammonium

Large plots (0.402 ha) of Evesboro loamy sand received 0, 13, 27, 54, and 179 metric tons/ha of poultry manure in the spring of 1972, 1973, 1974, and 1975. Five wells were established in each plot at depths of 3, 4, 5, and 6 m below the soil surface. In 1976, wells were established at 3- and 6-m depths in several other locations outside the plots. Corn (*Zea Mays* L.) was grown on these plots each year with no other additional fertilizer amendments. Water samples, taken regularly from these plots, showed that the concentration of nitrate at 3 m was affected by the application of poultry manure. At 4.5 and 6.0 m the effect was not

nearly as noticeable. There was a pronounced decrease in $\text{NO}_3\text{-N}$ concentration with increasing depth. The $\text{NO}_3\text{-N}$ concentration of water from some wells outside the plot area was quite high compared to the plot receiving no poultry manure, indicating that the source of the $\text{NO}_3\text{-N}$ in these well points was the poultry manure from treated plots. This suggested that the reduction in $\text{NO}_3\text{-N}$ at increasing depths under treated plots was partially a result of the lateral underground movement of nitrates. The concentration of $\text{NH}_4\text{-N}$ in the same water appeared to be only slightly affected, if at all. Application of poultry manure at rates higher than a crop can utilize results in nitrate movement through the soil profile and into the ground water. (Liebhardt-University of Delaware)

5733- B2, D3, E3, E4 THE USES OF DUCKWEED

Brookhaven National Laboratory
W.S. Hillman and D.D. Culley, Jr.
American Scientist, V. 66, No. 4, p. 442-451,
July-Aug., 1978. 2 fig., 3 tab., 59 ref.

Keywords: Duckweed, Wastewater treatment, Recycling, By-product recovery

The rapid growth, nutritional value, and high biomass productivity of duckweed is examined in terms of their use in water treatment, as feed crops, and in energy-efficient farming. Duckweeds are the smallest and simplest of flowering plants, a worldwide family (Lemnaceae) of floating monocotyledons. They have a very high relative growth rate. They grow in a stand. Almost the entire aerial portion of the stand may be harvested, and at rates and intervals that will maintain active growth and minimal crowding. Duckweeds absorb essential plant macronutrients at rates and in proportions that depend on the concentrations and the rate of harvest. Certain duckweeds seem to tolerate micronutrients in concentrations that might be expected to prevent growth. While this is important in terms of pollution control in waters, it might be limiting in terms of feeding the duckweed to animals. Excessive trace nutrient - or unambiguous poisons such as arsenate, arsenite, or selenite might well prove toxic as feed. Duckweeds would be most useful in operations sufficiently decentralized so that the plants are produced fairly close to where they will be utilized. While a number of possibilities for duckweed use are available, a duckweed/dairy farm was used as a prime example of such use. A model was presented in which about 4.5 tons of waste produced daily by a 100-head dairy herd went first to a collection pit and was then pumped to a fermentation unit. There methane was generated for supplementary energy, and the manure volume was reduced by about 50%; the nutrient loss was limited to ammonia gas, which could be recovered. The residue was then pumped, via a heat exchanger connected to the manure collection pit, into a system of duckweed lagoons. The duckweeds were periodically harvested, spray-washed, loaded on a feed trailer, and taken to a feeding trough to be mixed with other feeds. (Merryman-East Central)

5734- A11, B3, C2, D3, E3 A MONOGASTRIC-POLYGASTRIC SYSTEM DESIGNED TO USE HIGH LEVELS OF DISTILLERS FEEDS TO PRODUCE HUMAN FOOD

University of Missouri, Columbia, Missouri
J.M. Vandepopuliere, J.J. Lyons, and P.R. Lipeay
Proceedings, Distillers Feed Research Council, V. 33, p. 58-60, 1978. 2 tab., 4 ref.

Keywords: Refeeding, Distillers dried grains, Poultry wastes, Ensililing, Performance, Poultry, Sheep, Nitrogen

Distillers dried grains with solubles were fed at a level of 43.9% to cage layers. Egg production was comparable to that of control layers on a corn-soybean diet. However, egg weight and feed conversion were significantly poorer. Performance was not improved by addition of methionine, lysine and arginine. Fresh manure from caged hens fed corn-soybean meal and byproduct diets was ensiled. Wethers readily ate feeds containing the ensiled manure. Growth appeared to be related to intake. Corn silage produced a faster rate of gain. Weight gain and feed efficiency on the byproduct manure silage was numerically superior to the corn-soybean manure silage. It is possible that the numerical responses were due to the elevated nitrogen level. (Merryman-East Central)

5735- A8, B3, C2, E2 RECOVERY OF ^{15}N -LABELED FERTILIZER FROM MANURED AND SLUDGE-AMENDED SOIL

Instituto Nacional de Investigaciones Agrarias, Moncada (Valencia), Spain
F. Pomares-Garcia and P.F. Pratt
Soil Science Society of America Journal, V. 42, p. 717-720, 1978. 3 tab., 21 ref.

Keywords: Fertilizers, Land application, Cattle wastes, Sewage sludge, Nitrogen, Crop response, Soil chemistry

Research objectives were to evaluate crop recovery of fertilizer N in a manured and sludge-amended soil as calculated by different methods and also to determine N balances for the combinations of $(\text{NH}_4)_2\text{SO}_4$ and organic N sources. Manure was applied at 0, 20, 40, and 60 metric tons/ha and sludge was applied at 0, 10, 20, and 30 metric tons/ha in a greenhouse pot experiment. The wastes were combined factorially with 0, 50, 100, 150, and 200 mg N/kg soil as $(\text{NH}_4)_2\text{SO}_4$ labeled with ^{15}N , using barley and sudangrass as the test crops. No significant effect of both wastes and $(\text{NH}_4)_2\text{SO}_4$ rates on the overall inorganic N fertilizer recovered by the crops was found. Fertilizer nitrogen losses were 7.8, 9.1, and 13.1%, respectively, for control (unamended), manure and sludge treatments. With increasing rates of $(\text{NH}_4)_2\text{SO}_4$, nitrogen availability in the soil in terms of nitrogen from $(\text{NH}_4)_2\text{SO}_4$ increased in the control, remained almost constant with manure, and decreased with sludge amendments. (Merryman-East Central)

5736- B2, F1 SIZING LIQUID MANURE TANK WAGONS

J.N. Scarborough and D.H. Vanderholm
Prairie Farmer, p. 66, Aug. 5, 1978. 2 fig., 1 tab.

Keywords: Equipment-tank wagons, Liquid wastes, Economics

Guidelines are given for size selection in choosing liquid manure tank wagons. The number of trips required should be determined by dividing the quantity of liquid manure to be hauled annually by the wagon capacity. Travel time multiplied by the number of trips required equals the total hours of annual machine use. Purchase price of manure tank wagons can be expressed as a function of their capacity. Purchase price per gallon of capacity is not constant, but usually decreases as the tank size increases. For each volume of manure hauled annually, there is a manure tank wagon size which has the least annual cost. Costs are higher for too-small tank wagons because of the number of trips necessary - and extra time, fuel, and labor costs. With too-large wagons, the higher investment cost outweighs reduced operating costs. Selecting a tanker size larger than the least-cost size doesn't affect the annual cost greatly. However, selecting a tank wagon smaller than the optimum size can greatly increase the annual cost. (Merryman-East Central)

5737- A3, A4, B4, C1, E2 PHYSICAL QUALITY AND SEDIMENT TRANSPORT IN DRAINAGE WATER FROM A MANURED AND FERTILIZED CROPPING OPERATION

Animal Research Institute, Agriculture Canada, Ottawa, Ontario, K1A 0C6, Canada
N.K. Patni
Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes, V. 13, No. 3, p. 269-287, 1978. 1 fig., 7 tab., 13 ref.

Keywords: Land application, Dairy wastes, Sheep wastes, Poultry wastes, Agricultural runoff, Sediment, Dissolved solids, Water quality

A study was conducted to determine the physical and chemical quality of, and pollutant transport to drainage water in a large intensively cropped area where large quantities of liquid manure have been incorporated into the land every year since 1968. Results relating to the physical quality of the drainage water and solids transport are presented for the period between April, 1975 and Dec., 1977. It was found that, with proper management, good drainage water quality can be maintained. Specific conductivity measurements can be used for quick estimates of dissolved solids content in water. Most of the annual sediment transport takes place during snowmelt runoff. The amount of sediment transport is greatly influenced by hydrological conditions of flow. (Merryman-East Central)

5738-B1, C2, D3, E4 NUTRITIONAL VALUE OF ALGAL AND BACTERIAL PRODUCTS FROM MICROBIOLOGICALLY PRODUCED ANIMAL MANURES

Department of Poultry Science, Cornell University, Ithaca, New York
R.E. Austic, A.E. Henry, F.N. Yap, and W.G.

Pond
Proceedings, 1976 Cornell Nutrition Conference for Feed Manufacturers, Syracuse, New York, Oct. 31 and Nov. 1 and 2, 1976, p. 93-99, 4 tab., 23 ref.

Keywords: By-product recovery, Refeeding, Single cell protein, Algae, Yeasts, Bacteria, Poultry, Performance, Fermentation

Single cell proteins can provide a significant portion of the dietary protein required by domestic animals. The technology for production of single cell proteins (SCP) or SCP-containing products from animal waste is advancing rapidly. These sources of protein can contribute significantly to protein supplies for animal production, and reduce the environmental problems which stem from intensive animal agriculture. Studies which have been conducted show that algal protein from animal waste may provide a substantial fraction of the required dietary protein. The production of yeast on petroleum residues has led to an upsurge in interest in the potential of yeasts for animal feeds. The results of a number of investigations indicate that 15% is a practical upper limit for yeasts for starting chicks. It has been suggested that only 10% yeast could be included in broiler starter diets, but finishing diets could contain up to 20% without depressing broiler growth. Much less is known about nutritional value of bacterial proteins than those of yeasts and algae. The culture of bacteria on animal manures has not been widely investigated. One study on continuous aerobic fermentation for the conversion of poultry manure to a product rich in bacterial protein was done. The heat-dried product created from this bacterial protein was tolerated by young chicks at a level of 20%. A lyophilized product which was created was tolerated less well. (Merryman-East Central)

5739-A4, B1, F2 NON-POINT POLLUTION AND THE SCS

Anonymous
Agricultural Engineering, V. 59, No. 5, p. 19-20, May, 1978.

Keywords: Nonpoint pollution, Legal aspects, Soil Conservation Service, Environmental Protection Agency, Culver Amendment, Best management practices

Glen H. Loomis, director of the Environmental Services Division of the U.S. Department of Agriculture-Soil Conservation Service, discusses the Culver Amendment to the Clean Water Act which provides authority for the Secretary of Agriculture, cooperating with the administrator or EPA, to set up programs and to enter into contracts for not less than five nor more than ten years - contracts which will incorporate best management practices to control non-point pollution. Soil conservation districts will play an important role in developing such contracts because of their knowledge and understanding of local situations. The Culver Amendment provides for 50% cost sharing unless there are major offsets benefits or unless that rate would prevent the participant from entering the program. The Soil Conservation Service will provide technical assistance, prepare and transmit budget requests, develop key reports, prepare plans and contracts, and provide training programs. The ASCS will furnish data on land use, crop history, and cost-shared conservation measures. Also,

ASCs will review plans and contracts to assure coordination with other farm programs. (Merryman-East Central)

5740-B2, D3 THE PERFORMANCE OF A PLUNGING JET AERATOR AND AEROBIC TREATMENT OF PIG SLURRY

National Institute of Agricultural Engineering, Silsoe, Bedford, England
R.W. Sneath
Water Pollution Control, V. 77, No. 3, p. 408-420, 1978. 11 fig., 8 tab., 15 ref.

Keywords: Equipment-aeration, Slurries, Swine wastes, Aerobic treatment

Experiments were done to test the performance of a plunging jet aerator in water using a standard method. In 6 experiments on continuous aerobic treatment of separated pig slurry, the effect of solids retention period, heat production and quality of treated slurry were evaluated. The plunging jet aerator is an aerator which can be used in any tank. The aerator consists of a large capacity pump which circulates liquor from the treatment tank through a nozzle. The resulting jet plunges into the liquid surface forming an unstable vortex and an intensely-mixed cone-shaped zone of liquid and bubbles where gas transfer takes place. Only the suction pipe of the pump needs to be immersed, and the nozzle can be positioned conveniently above the liquid surface. The pump can also be placed in a convenient position away from the liquid being aerated, thereby ensuring easy maintenance; these features give the plunging jet aerator the potential for farm use. Tests with the aerator yielded the following conclusions: (1) The plunging jet aerator used in a treatment plant with a short SRP seems suitable for the treatment of farm waste due to its simplicity and easy maintenance. Such plants are likely to be cheap to build and run due to the small capacity required. Since the treated slurry will be applied to crops, loss of nitrogen can be counted as a cost of treatment and this can be minimized by treating at a short SRP. (2) Results of continuous treatment experiments showed that the quality of treated slurry can be predicted using results of work from laboratory fermenters provided that the quality of the slurry to be treated is accurately known. (3) Calculation of oxygen consumption from the heat evolved from the plant compared favorably with the COD removal rates and may be a useful check on oxygen consumption for other plants. In practice some of the heat lost from the treatment plant could possibly provide a source of low-grade space or water heating for the pig unit. (Merryman-East Central)

5741-A2, B2, B4, D1, D3, E2 SYSTEMS OF RUNOFF CONTROL

University of Illinois
D.H. Vanderholm and J.C. Nye
Pork Industry Handbook, PIH-21, 6 p. 3 fig., 3 tab.

Keywords: Feedlot runoff, Design, Waste storage, Settling basins, Holding ponds, Dewatering, Infiltration, Vegetative filters

While rainfall and snowmelt are the major

causes of runoff from feedlots, urine and leakage from waterers also cause runoff in some situations. Design flow and storage capacities are usually based on rainfall intensities and amounts. Runoff control is discussed in terms of clean water diversion, runoff collection, settling basins, holding ponds, dewatering equipment, and infiltration areas. Design information is given. (Merryman-East Central)

5742-B2, B3, C1, C2, D3, E3 PRODUCTION OF A RUMINANT PROTEIN SUPPLEMENT BY ANAEROBIC FERMENTATION OF FEEDLOT WASTE FILTRATE

Department of Microbiology and Public Health, Michigan State University, East Lansing, Michigan 48824

C.A. Reddy and M.D. Erdman
Biotechnology and Bioengineering Symposium No. 7, "SCP from Renewable and Nonrenewable Resources," p. 11-22, 1977. 6 tab., 19 ref.

Keywords: Feedlot waste filtrate, Fermentation, Carbohydrates, Anaerobic, Refeeding, Waste composition

Michigan State University experiments have indicated that feedlot waste filtrate (FLWF), which is low in carbohydrate, is not practical to ferment without supplemental carbohydrate added. FLWF obtained from 1:1 or 1:9 diluted FLW can be supplemented with other agricultural wastes, rich in carbohydrates, and fermented successfully to yield a product which when concentrated fivefold contains 20% or higher amount of crude protein. Whey, molasses, corn starch, or starch from potato processing wastes supplementation to FLWF will yield a product similar in crude protein content, but significantly different in volatile fatty acid content. The simple and efficient fermentation process which has been developed has the following advantages: (1) The process, which is anaerobic, eliminates high equipment costs which are involved in aeration. (2) There is no requirement for supplementation with growth factor sources and separate inoculum need not be added. There is no need for sterilization of the medium or observing other aseptic conditions, and the product is fairly uniform. (3) Added carbohydrates are rapidly fermented. (4) The process is simple and easily adaptable to existing industrial technology and does not require any specially trained individuals for the actual operation. (5) The product produced is stable and is not subject to microbial spoilage for several months when stored at 25°C. (Merryman-East Central)

5743-B2, C2, D3, E2, E3 NATURAL GAS FROM AGRICULTURAL WASTES

W.J. Jewell
Engineering Cornell Quarterly, V. 12, No. 1, p. 14-24, Spring, 1977. 22 fig., 1 tab.

Keywords: Anaerobic, Fermentation, Design, Methane, Pollution control, Land application

The national energy policy now under development will probably encompass at least three components: conservation, increased use of coal, and the development of renewa-

ble, clean energy sources. Anaerobic fermentation of manure and other agricultural wastes, as well as other organics, is a particularly attractive alternative for renewable, clean energy because it can supply a significant amount and simultaneously provide pollution control and allow valuable plant nutrients to be recycled. Cornell University has been studying bioconversion since 1973. Three different types of cow manure anaerobic fermentors (conventional, batch-loaded, and plug-flow) were designed and tested. The systems were evaluated in long-term laboratory tests, including measurements of gas production. The least expensive system was the plug-flow design. The Cornell study indicated that biogas conversion appears to be feasible for energy generation, pollution control, and nutrient conservation in many agricultural operations. Furthermore, it is reasonable to assume that improvements in fermentation technology can make the process even more attractive. The ongoing Cornell study is attempting to estimate the improvement that might be made with innovative applications and development of fundamental information. (Merryman-East Central)

5744-A11, B2, B3, C2, E3 NUTRITIONAL VALUE OF PIG MANURE

Institute of Animal Science, Rolighedsvej 25, DK 1958, Copenhagen, Denmark
B.O. Eggum

The International Conference of the 1976 International Pig Breeding Exhibition, Reggio Emilia, Italy, May 1, 1976, 27 p. 2 fig., 13 tab., 17 ref.

Keywords: Refeeding, Swine wastes, Waste composition, Dried swine wastes, Cattle, Swine, Performance

Average daily swine waste output amounts to about 1.0 kg of total solids per 100 kg live weight. Eight percent of the fecal solids are classified as volatile solids and are subject to oxidation. Chemical composition of swine wastes varies. Chemical analysis of artificially dried swine wastes showed a content of about 20% protein, 7.5% fat, 30% N-free extracts, 18% fiber, 16% ash and 6-7% water. The fat fraction contains high proportions of palmitic and stearic acids. The wastes also have relatively high contents of lysine, threonine and isoleucine. A high fiber and ash content indicate a low digestible energy concentration. Experiments have shown that dried swine wastes can contribute about 15% of the diets to monogastric animals without adverse effects on daily gain or feed conversion. When oxidation ditch residue (ODR) was fed to rats, weight gain of rats fed 0 and 10.3% ODR were similar and significantly greater than rats fed 20.8% and 31.0% ODR. The gain/feed ratio decreased linearly with additions of ODR. Diet acceptability was not reduced when ODR was fed. Other studies indicated that dried anaerobically maintained wastes were ineffective as a source of nutrients. Similar results were obtained in experiments with pigs. In experiments with bulls fed 40-50% swine wastes plus some hay over a 48-day period, the bulls had a daily gain of 1.1 kg. Increasing amounts of dried swine slurry solids caused a decrease in the energy concentrations in the diets. In comparison with swine manure, the feed value of swine slurry is assumed to be 10-20% lower and depends on the proportion in the ration. While the feed value of pig manure is comparable

with dried alfalfa, swine waste solids can be placed between straw and hay of average quality. (Merryman-East Central)

5745-A11, B3, C1, C2, D2, E3 A NOTE ON UTILIZATION OF DIFFERENT LEVELS OF AUTOCLAVED LITTER NITROGEN OF LAYING HENS BY CROSS-BRED BULL CALVES

College of Veterinary Science, Tirupati, India 517502

M. Parthasarathy and D.A. Prasad
Indian Journal of Animal Science, V. 46, No. 6, p. 321-323, June, 1976, 4 tab., 5 ref.

Keywords: Refeeding, Poultry litter, Auto-claving, Nitrogen, Cattle, Performance

A study was conducted which determined that 10% addition of autoclaved poultry litter from laying hens may be the optimum level which can be fed in rations of growing crossbred bull calves. The autoclaved litter was included at 10, 20 and 30% (rations 1 to 4 respectively) in the concentrate mixtures, so that the nitrogen in the control mixture was replaced by 0, 8, 16 and 24% by the litter nitrogen respectively. All the 4 concentrate mixtures were computed to be isocaloric and isonitrogenous. Four yearling bull calves were fed about 3 kg paddy straw and 2 kg concentrate mixture in equal proportions twice daily in a conventional 4 x 4 latin-square nitrogen balance trial. Each period of the latin square comprised a 10-day preliminary period followed by a 5-day collection period. Samples of feed and feces were analyzed in duplicate for proximate constituents and urine for nitrogen according to AOAC methods. Dry-matter digestibility of the rations containing 20 or 30% autoclaved poultry litter was significantly lower ($P < 0.05$) than the ration with no poultry litter. However, there was no significant difference in dry-matter digestibility of rations containing 10% litter and no litter. Although nitrogen digestibility in the litter-containing rations tended to be lower, the differences among treatments were statistically not significant ($P > 0.05$). The level of poultry litter in the rations had no significant effect on the digestibility of ether extract, crude fiber and nitrogen-free extract. Fecal and urinary nitrogen excretion were not significantly different. (Merryman-East Central)

5746-A6, A7, A10, A11, A12, B3, C1, C2, D1 PARTIAL DRYING OF POULTRY MANURE USING IN-HOUSE AIR

Agricultural Experiment Station, College of Agriculture and Forestry, West Virginia University, Morgantown, West Virginia 26506
R.A. von Oheimb and A.D. Longhouse
Bulletin 633T, West Virginia University Agricultural Experiment Station, Sept., 1974, 16p. 5 fig., 1 tab., 25 ref.

Keywords: Air pollution, Dehydration, Design, Physical treatment, Moisture content, Ammonia, Odor control, Vectors, Fly control, Animal health, Public health

The auxiliary air system designed for in-house drying was capable of reducing the manure

moisture content from 80 percent to 24 percent (wet basis) over a period of seven days when the average in-house temperature and relative humidity were approximately 21°C and 50 percent, respectively. The use of in-house air blown over the manure as it accumulates under the cages is an extremely effective means of reducing odors, particularly ammonia, and other vectors such as flies. Obviously, this improves the environment in the house for both birds and humans. The maximum ammonia concentration did not exceed 0.45 parts per million (ppm). (von Oheimb-West Virginia University)

5747-A6, B2, D1, D3, E3, F1 LAGOON DEODORIZER

Anonymous
National Hog Farmer, p. 34, May, 1976, 2 fig.

Keywords: Design, Waste treatment, Lagoons, Aeration, Odor control, Economics

Bob George, a University of Missouri agricultural engineer has devised a system for maintaining an odorless aerobic layer of liquid on the surface of slurry lagoons. He built a giant cross shape from 2 inch plastic pipes and floated it on the lagoon on polystyrene floats. Each arm of the cross has 1/4 inch holes drilled on one side. The ends are sealed with caps. When lagoon liquid is pumped through the pipes it forms a thin aerated layer on the surface. The holes are arranged to direct the liquid in a circular motion so that the whole surface is covered. One hole is necessary for every 1000 ft. of surface area, and the holes are spaced closer together towards the ends of the arms. (Merryman-East Central)

5748-A6, A10, B3, D1 PARTIAL IN-HOUSE DRYING AND MECHANICAL REMOVAL OF MANURE FROM CAGED LAYING HENS

Agricultural Experiment Station, College of Agriculture and Forestry, West Virginia University, Morgantown, West Virginia 26506
A.D. Longhouse
Bulletin 632T, West Virginia University Agricultural Experiment Station, Sept., 1974, 16 p. 9 fig., 4 tab.

Keywords: Dehydration, Poultry wastes, Odor control, Fly control, Design, Conveyor belts

A substantial portion of the moisture in poultry manure may be evaporated by using in-house air as the manure accumulates beneath the cages. This reduces the weight of the manure removed, improves its handling characteristics, and helps control odors and flies. The use of conveyor belts under cages provides an extremely effective means of removing the manure and contributes to the control of odors and flies. The belts eliminate the need for labor to periodically clean the nits used in many cage systems. The data presented in Table 3 is for one strain (Babcock 300) of laying hens for two months (June and July). Tests will be run during the cold weather months to determine the effectiveness of room air to remove moisture from the manure. As the auxiliary air rate (cfm/bird) increased, the rate of the exchange air decreased from the beginning

rate (four cfm/bird) when no auxiliary air was used. This was not intended to occur, but it may be a desirable means of controlling the rate of exchange during cold weather if only the air supply (fan) is used to recirculate and exchange air. Placing cages vertically makes it possible to house more birds on the same floor area than with the stair-step system. (Longhouse-West Virginia University)

5749-A11, B3, E3 INFLUENCE OF DIETARY SOURCES OF NITROGEN ON BLOOD UREA NITROGEN OF SHEEP

Utah State University, Logan, Utah
W. Plummer, K.S. DeLew, and J.E. Butcher
Utah Academy Proceedings, V. 53, Part 1, 1976.

Keywords: Cattle wastes, Nitrogen, Blood urea nitrogen, Refeeding, Sheep, Performance, Animal health

Twelve mature wethers were stratified by weight into three treatment groups. Group 1 consisted of four animals fed 3.2 lbs. chopped alfalfa hay per day (18% crude protein). Group 2 contained four animals that were fed 5.2 lbs. of a mixture composed of 44.5% chopped alfalfa, 44.5% dried cow manure, 8% molasses and 3% corn oil per day (18% crude protein); and group 3 consisted of four animals that were fed 3.2 lbs. of chopped alfalfa with a 1% urea solution added during the chopping (22% crude protein). These feeding levels were based on previous feeding trials with approximately equal energy intake, but the total and available protein was of some concern. The animals were allowed a 21-day transition period and were bled the day before being put on the above rations (day 0), in the middle of the transition period (day 9), and twice a day after transition (days 21, 24, 27, and 28). The blood was centrifuged and the serum was drawn off. Blood urea nitrogen (BUN) levels were determined for each sample. The BUN on day 0 was not significantly different for the three groups, and there was no significant difference between the alfalfa and the alfalfa-plus-urea groups for the entire study, although there was a trend for the alfalfa-plus-urea to have higher BUN levels. However, the alfalfa-plus-manure group had a significantly depressed ($P < .01$) BUN, as compared to the other two groups, for bleedings on days 9, 21, 24, 27 and 28. The day 0 level was 20.75 mg%, and on day 28 the level was 17.5 mg%. This compares with the day 0 and day 28 BUN of 22.5 mg% and 25.25 mg%, respectively, for the alfalfa and 22.5 mg% and 27.0 mg%, respectively, for the alfalfa-plus-urea. Other research at this station has shown a decreased weight gain or weight loss from feeding high levels of manure (up to 75%). The current study was undertaken to determine if an adverse effect of source of feed nitrogen caused the weight losses. As shown by this experiment in correlation with the added urea, the manure feeding resulted in a decrease in BUN levels. Therefore, it may be concluded that high levels of this type of manure do not cause weight losses as a direct result of increased blood urea nitrogen from this feed protein source. (Plummer-Utah State University) (Abstract only)

5750-A11, B3, D1, E3 BEEF MANURE AS A FEED FOR

BREEDING EWES

Utah State University, Logan, Utah
J.V. Bolter, J.E. Butcher, and W.C. Foote
Proceedings, Western Section, American Society of Animal Science, V. 25, p. 297-299, 1974. 1 fig., 4 ref.

Keywords: Cattle wastes, Feedlot wastes, Digestibility, Refeeding, Sheep, Animal health, Dry matter, Phosphorus

Beef feedlot manure was compared to alfalfa hay for dry matter digestibility, organic matter digestibility, and effectiveness of maintaining breeding ewes using 7 mm pelleted feed. One trial using 0, 75, and 87.5% manure mixed with alfalfa indicated the dry matter digestibility of beef feedlot manure to be 43.8% or 77% as good as the alfalfa. A second trial indicated a lower value for manure, at 51% the value of alfalfa. These data, plus gross chemical analysis of beef feedlot manure indicate large variabilities in the feeding value of such manure, although all feed samples met minimums in nitrogen and phosphorus. Sixty-nine aged ewes were stratified by weight into three treatments, 100% alfalfa, 50:50, and 25:75 alfalfa: manure. These ewes were fed the experimental feed for 30 days prior to breeding. Ovulation rate, determined by laparotomy were 1.86, 1.95, and 1.77 per ewe for the 0, 50, and 75% manure levels, respectively. An attempt had been made to adjust the feed intake on the basis of the digestibility studies so that all three groups would have equal gains. After 130 days of group feeding, the average body weight changes were +6.7, +3.8 and +6.5 kg per ewe for the 0, 50, and 75% manure treatments, respectively. These body weight changes were not significant, however, because the ranges involved were +1.4 to +17.3, -2.3 to +10.5 and -19.1 to +6.4 kg for the 0, 50, and 75% manure treatments, respectively. (Bolter-Utah State University)

5751-A8, A10, B3, D2 THE IMPACT OF FORAGING MEADOWLARKS, *STURNELLA NEGLECTA*, ON THE DEGRADATION OF CATTLE DUNG PADS

Department of Entomological Sciences, University of California, Berkeley, California 94720
J.R. Anderson and R.W. Merritt
Journal of Applied Ecology, V. 14, p. 355-362, 1977. 2 tab., 9 ref.

Keywords: Forages, Meadowlarks, Degradation, Cattle wastes

In 110 h of observations over four years only the western meadowlark (*Sturnella neglecta*) was seen foraging in cattle dung pads. Field examination of dung pads with and without digested barley seeds (the former from cattle provided a supplemental autumn-winter ration of cottonseed meal and barley), and gizzards of twelve meadowlarks killed during winter, showed that they were foraging in pads for barley seeds, not insects. This appears to be the first report of a bird species utilizing cattle dung pads in pastures as an autumn-winter foodsource for seeds. The meadowlarks tore apart dung pads in open rangeland pastures and pastures with eight to ten trees/ha. Meadowlarks were not present in natural woodland ranges (100-175/ha) and dung pads here were not disrupted by

foraging birds. Autumn-winter flocks of meadowlarks fed from dung pads containing barley seeds from late October until early March, with maximum foraging in December and January. In pastures where meadowlarks occurred, about 20% of the dung pads with seeds were pecked apart in October and March and 67-74% were pecked apart. After twelve to fifteen months, 90-100% of the ground surface originally covered by the pad pecked apart by meadowlarks was covered with newly sprouted vegetation. By contrast, a dried out, intact dung pad inhibited the vegetation growth for two to three growing seasons. Wind, winter rains and sprouting vegetation in spring accelerated the degradation of cattle dung pads torn apart by meadowlarks. (Merritt-Michigan State University) (Blackwell Scientific Publications Limited)

5752-B3, C1, C2, D2, E3 A NOTE ON SOME CHEMICAL CHARACTERISTICS OF IN VITRO MANURE/MOLASSES SILAGE

Instituto de Ciencia Animal Apartado 24, San Jose de las Lajas, Habana
C. Hardy and A. Elias
Cuban Journal of Agricultural Science, V. 8, p. 285-289, 1974. 3 fig., 9 ref.

Keywords: Ensilage, Waste composition, Cattle wastes, Molasses, Silage, Fermentation, Nitrogen, pH, Refeeding, Urea

Chemical characteristics of an ensiled mixture made of cattle manure, final molasses, ground sorghum hay and urea were determined. The mixture was packed into 15 laboratory glass-silos, which were sealed and analysed at 1, 2, 4, 8, 15, 21, 28, and 35 days after storage at room temperature. The pH increased from 6.4 to 7.6 within 24 hr and then slowly declined until 4.8. After the 8th day there was a substantial VFA formation and destruction of any lactic acid which had accumulated before the first 4 days. Insoluble-N expressed as a percentage of the total N increased almost tenfold during the first 8 days, while soluble N decreased to almost half its initial value. (Hardy-Instituto de Ciencia Animal)

5753-B3, C1, C2, D2, E3, F1 PRETREATMENT OF CELLULOSIC WASTES TO INCREASE ENZYME REACTIVITY

Department of Agricultural Engineering, Colorado State University, Fort Collins, Colorado 80523
N. Nasse, J. Wallick, and J.M. Harper
Biotechnology and Bioengineering, V. 19, p. 323-336, 1977. 4 fig., 2 tab., 19 ref.

Keywords: Hydrolysis, Cellulose, Cattle wastes, Autoclaving, Enzyme reactivity, pH, Waste treatment, Steam, Economics

The enzymatic hydrolysis of cellulose to glucose is generally a slow reaction. Different pretreatments, such as ball milling to a -200 mesh or swelling in 1-2% NaOH are reported to increase the reactivity considerably. In this work a fiber fraction from cattle manure was treated in an autoclave for 5-30 min at temperatures ranging from 130-200°C. The

reactivity of the cellulose, measured by incubating samples with a commercial cellulase preparation for one hour at 50°C and pH 4.8, was increased by a factor of 4-6 compared to NaOH treatment and 10-12 compared to untreated fiber. The increased reaction rate is probably mostly due to an increase in cellulose availability to enzymatic attack, as structural hemicellulose is hydrolyzed and removed during the treatment. Sugars, produced by hemicellulose hydrolysis, will react further to give caramelization products. These side reactions were shown to be suppressed by short treatment times. The treated fiber could support growth of a mixed culture of *Trichoderma viride* and *Candida utilis* only after washing, indicating the formation of water soluble inhibitory products during treatment. The treatment with high temperature steam can probably be used also with other cellulosic materials to increase reactivity. This may be an attractive way to prepare low-valued wastes such as manure fibers, straw, stalks, or corn cobs for fermentation processes to increase the protein content or for use directly as ruminant animal feed. (Nease-Colorado State University) (Reprinted by permission of John Wiley & Sons, Inc.)

5754-B3, C1, D2, D3, E3 PILOT PLANT RESULTS FOR PARTIAL OXIDATION OF CAT- TLE FEEDLOT MANURE

Department of Chemical Engineering, Texas Tech University, Lubbock, Texas 79409
S.R. Beck, W.J. Huffman, B.L. Landeene, and J.E. Halligan
Industrial and Engineering Chemical Process Design and Development, V. 18, No. 2, p. 328-332, 1979. 5 fig., 2 tab., 5 ref.

Keywords: Oxidation, Feedlot wastes, Moisture content, Dehydration, Gases, Pyrolysis, Ethylene

A small pilot plant (capacity, 450 kg/day) has been constructed to evaluate gasification of manure by partial oxidation. The reactor operates as a countercurrent, fluidized bed in which air-steam mixture is the fluidizing medium and manure is the only solid phase present. The product gas from this process contains a significant amount of hydrocarbons (CH_4 ~10%, C_2H_6 ~8%) in addition to normal partial oxidation products. The net heating value of the dry gas exceeded 8.6 MJ/m³ (1 atm, 0°C) in all cases. The net heating value sign and operating procedure are described as are the results of the heat and material balances. The work confirms the technical feasibility and potential scale-up for producing a medium heating value gas suitable for fuel or for feed to a petrochemical production process at relatively high yields from cattle feedlot manure. (Beck-Texas Tech University)

5755-A8, B2, C2, D1, E2 EXPERIMENTS ON THE FERTI- LIZING VALUE OF ANIMAL SLURRIES. PART II. THE USE OF PIG SLURRY ON SPRING BAR- LEY

N.A.A.S. Yorkshire and Lancs. Region
H.T. Davies
Experimental Husbandry, V. 19, p. 61-64, 1970.

Keywords: Swine wastes, Nitrogen, Slurries, Land application, Barley, Crop response, Waste composition, Calcium, Magnesium, Potassium, Phosphorus

Experiments were conducted from 1985 to 1987 to study the effects of nitrogen in pig slurry and fertilizer on the grain yield of spring barley. Each year significant increases in grain yield were obtained. There was wide variation in the values obtained for the efficiency of the nitrogen in slurry. Slurry was more efficient when applied at low rates than when applied at high rates. When slurry nitrogen was applied up to its highest level, no depression of yield was found. If slurry was applied in mid-winter, about a quarter of the nitrogen became available to the barley crop; when applied right before sowing in the spring, between a quarter and three quarters were available. (Little-East Central)

5756-A6, A11, B1, B2, B3, C1, C3, F1 OPTIONS FOR MANAGING WASTE WITHIN THE BUILDING

Department of Animal Sciences, Purdue University, West Lafayette, Indiana 47907
A.L. Sutton, J.C. Nye, and D.H. Bache
Presented at NPPC Swine Housing-Management Symposium, Des Moines, Iowa, Oct. 15-16, 1975, p. 1-15.

Keywords: Swine wastes, Waste management, Economics, Odor control, Confinement pens, Design, Waste storage, Performance

The following factors should be considered when choosing a waste management system: (1) Investment and operating costs, (2) Labor requirement and availability, (3) Level of management required, (4) Personal preference of operator, (5) Existing equipment and facilities, (6) Odor potential, (7) Water pollution control, (8) Effect on animal performance, (9) Fertilizer value of waste, and (10) Size and location of operation. The advantages and disadvantages of the numerous swine waste management options available to the producer were given. The options were: (1) Total slotted floor - deep pit storage, (2) Total slotted floor - oxidation ditch with outside storage, (3) Partial slotted floor - deep pit storage, (4) Partial slotted floor - shallow pit with outside storage, (5) Partial slotted floor - flush gutter with outside storage, (6) Concrete floor - open flush gutter with outside storage, and (7) Concrete floor - bedding in an open fronted shed with outside lot. Producers are encouraged to seek design information and technical advice when planning a waste management system. The personal preference of an individual producer is important since each waste system described can work successfully with proper management and design. (Little-East Central)

5757-A11, B2, B3, C2, D1, E3, F1 PRODUCTION POTENTIAL OF RUMINANTS AS INFLUENCED BY THE REFEEDING OF SCRE- ENED CATTLE MANURE SOLIDS

Department of Animal Science, North Carolina State University, Raleigh, North Carolina 27607

W.L. Johnson
ANS Report No. 226, Meeting on "Role of Livestock in the Future World Food Supply", p. 1-8, April 21-22, 1975. 2 tab., 3 ref.

Keywords: Cattle wastes, Fertilizers, Refeeding, Economics, Palatability, Screened manure solids, Animal health, Performance, Waste composition

The results of feeding screened manure solids (SMS) as a part of the ration for Jersey steers were described. The work with SMS was conducted to assist in environmental pollution control and to improve feed utilization in cattle. SMS is a virtually odorless product which upon drying looks like the partially digested residue of fiber from the roughage portion of the animal's original ration. This material can be used as bedding in dairy freestalls or it can be spread in the freestalls in wet form with no problems. The liquid contains most of the fertilizer value of the original manure. The crude protein content of SMS was considerably lower than that of whole cow manure (17%). A trial was conducted to test the palatability of rations with SMS. One ration contained SMS at 33 and 45% of total dry matter. The remaining ingredients were corn silage, and a standard 19% protein dairy concentrate mix. Intake was found to be satisfactory as long as the rations were mixed daily with fresh SMS. After standing 24 hours, the palatability declined. It was found that the separation of cattle manure into two fractions, one of high fertilizer value and the other with little value as fertilizer but with other potential uses, could significantly improve the overall efficiency of resource utilization in intensive confined cattle operations. By refeeding the fibrous solids fraction, some additional nutritional value could be extracted which would otherwise be wasted. (Little-East Central)

5758-A8, B1, B2, B3, C1, C2, D3, E2, F1 SWINE WASTE VALUES FOR FERTILIZER AND REFEEDING

Department of Animal Sciences, Purdue University, West Lafayette, Indiana 47907
A.L. Sutton
Great Plains Livestock Conference, Hastings, Nebraska, March 27, 1976, p. 23-33. 5 tab.

Keywords: Swine wastes, Fertilizer, Nitrogen, Land application, Waste management, Refeeding, Economics, Waste composition, Phosphorus, Potassium, Crop response

This paper discussed the potential value of swine waste as a fertilizer and feed resource. Swine wastes contain a relatively rich source of the major fertilizer nutrients, nitrogen (N), phosphorus (P) and potassium (K) as well as several other minerals. Due to several factors, the type and amount of nutrients in swine manure and their eventual availability for plant and animal use can vary considerably from farm to farm. These factors are: the nutrient composition and type of ration fed to the swine; the method of waste collection and storage; and the amount of feed, water wastage and bedding used. The type of housing and/or waste handling system can effect the nitrogen losses in manure. There is considerable nitrogen loss when manure is exposed for long periods of time to the weather. For land application, the extent of plant nutrient benefit from swine waste greatly depends upon the time and method of waste application, soil characteristics, and type of crop grown at the disposal site. The physical properties of soil affect how much

manure can be safely applied to the land. Animal waste application to soils has the distinct advantage of enhancing soil structure and increasing organic matter content, thus improving soil tilth, nutrient-holding capacity and water retention. If the fertilizer needs of the crops grown on the land and the approximate nutrient value of the swine manure are known at the time of application, one can determine how much manure can safely be applied to the land and if additional commercial fertilizer would be needed for efficient crop production. A waste disposal system should not be chosen only on the basis of the fertilizer value of the waste. Labor, fuel, equipment requirements, and costs are important items to consider in selecting a waste disposal system. From the studies that were performed, it appeared that nutrients in swine wastes were inadequate as feed ingredients for swine rations unless the waste had been processed in some extensive manner which may be uneconomical and require considerable management. (Little-East Central)

**5759-A6, A8, B1, B2, C2, E2, F1
LAGOON WASTE: CASH BEHIND
BANKS**

D. Eselinger
Missouri Ruralist, V. 120, No. 12, p. 6, 7,
July, 1979.

Keywords: Irrigation, Land application, Confinement, Swine wastes, Lagoons, Economics, Phosphorus, Potassium, Effluent, Waste management, Flushing

Mr. Lewis Wilson, of Audrain County Missouri, built a 400-head capacity confinement feeding barn with waste handling system. This finishing facility was 54-by-210-foot gutter-flushed confinement barn. The system was designed by the Extension specialists at the University of Missouri-Columbia and met all standards established by the Missouri Department of Natural Resources. The waste was flushed to a lagoon from which 50 acres of cropland were irrigated. The effluent at the sprinkler contained 190 pounds of nitrogen, 52 pounds of phosphorus (P_2O_5) and 180 pounds of potassium (K_2O) per acre-inch. At today's local fertilizer prices, that was a \$4,600 value annually. Around 4,000 feet of underground pipe transported the effluent from the lagoon to the field. Water was pumped from a creek to replace the 6 feet in the lagoon. Another 2 inches of effluent was then applied from the lagoon. The irrigation system was designed to pump lagoon effluent that contained some solid material. This waste handling system required very little labor. Two 1-inch irrigation applications required only about 25 man-hours per year. The objective was that all animal waste must be kept on the farmer's own land and must not enter underground water supplies. (Little-East Central)

**5760-A8, B3, C2, E2
EXPERIMENTS ON THE FERTILIZING VALUE OF ANIMAL SLURRIES. PART III. THE USE OF POULTRY AND MIXED SLURRIES ON GRASSLAND**

N.A.A.S. Yorkshire and Lancs. Region
H.T. Davies and C.G. Chumbley
Experimental Husbandry, V. 19, p. 65-68,
1970.

Keywords: Poultry wastes, Nitrogen, Slurries, Land application, Grassland, Dry matter, Animal wastes, Potassium, Phosphorus, Calcium, Magnesium

Experiments were conducted in East Yorkshire, and Shropshire, England to determine the efficiency of the nitrogen content of poultry slurries compared with mineral fertilizer when applied to grassland cut for conservation. Yields of herbage dry matter obtained were compared with those from levels of fertilizer nitrogen. At both sites good responses in yield were obtained from fertilizer nitrogen and the nitrogen in slurries. At the Yorkshire site, there was no difference in yield in winter, when applying increments of poultry slurry, than when applying the total amount in spring. The efficiency of the nitrogen in the slurry was estimated at 66 percent. At the Shropshire site, there were no significant differences between times of application indicating an efficiency of the nitrogen content rising from 50 percent for application in October to nearly 100 percent for application in February. Data on soil and rainfall were given. (Little-East Central)

**5761-A6, B2, C3, E3
PROTEIN-RICH ALGAE FROM
SWINE WASTES**

Anonymous
Compost Science, V. 20, No. 3, p. 2,
May-June, 1979.

Keywords: Swine wastes, Algae, Recycling, Odor, Flocculation, Slurries, Aluminum sulfate, Lagoons, Refeeding, Mixing

Dr. E.P. Lincoln and his associates at the University of Florida have been feeding pigs a protein-rich algae produced from liquid swine wastes. They have found algae production is an economical and ecological way to use these wastes. During recycling, the liquid wastes flow from the pig pens into an anaerobic lagoon. As the level in the lagoon rises, the wastes flow into a system of four connecting channels. The algae grown in these channels eliminates odor, removes pollutants, and yields up to 10 times the amount of protein obtainable from a soybean field. Everyday the last channel is harvested by flocculation. Tank wastes are then placed in a swirl separator and mixed with aluminum sulfate. This makes the algae float to the top, forming a thick blanket of slurry. The separated water is returned to the first channel and the slurry is pumped to a storage tank where it is dried. A protein-rich solid which can be ground and incorporated into swine feed is the final product. (Little-East Central)

**5762-B2, B3, E2, E3, F2
MANUAL FOR WASTES**

Anonymous
Missouri Ruralist, V. 120, No. 12, p. 6, July,
1979.

Keywords: Guidelines, Waste management, Waste handling, Land runoff, Waste disposal

"Missouri Approach to Animal Waste Management" (Manual 115) is the effort of the University of Missouri-Columbia Extension Division and the Missouri Department of Natural Resources to set up guidelines for

efficient waste management. The Missouri approach to waste management is that farmers handle waste on their own land to avoid runoff and pollution of either surface or underground water supplies. This manual was written for livestock owners, engineers and others who design and manage waste handling systems. The manual was based on research and experience with application of the technology on Missouri farms. Material on biological treatment, separation of solids and liquids, return of waste to the land, soil-plant filters and economics of waste collection and disposal were included in the publication. (Little-East Central)

**5763-A8, B2, B5, C1, C2, E2, F1
CALCULATIONS FOR EFFICIENT
USE OF NUTRIENTS IN LIVESTOCK
SLURRIES ON GRASSLAND**

Department of Agricultural Engineering,
University of Newcastle upon Tyne
J.R. O'Callaghan
ADAS Quarterly Review, No. 27, p. 155-167,
Winter, 1977. 1 fig., 9 tab., 8 ref.

Keywords: Livestock wastes, Slurries, Grass, Economics, Water pollution, Nitrogen, Phosphate, Potash, Computer model, Land application, Waste management, Crop response, Fertilizer, Animal wastes

Computer programs are available to estimate the area and appropriate amounts of livestock slurries to be applied to grassland for efficient use of slurry fertilizer value. These estimates are valid provided that the assumptions described remained realistic for the overall management system under consideration. Grass was most suited to slurry application. It had a high nitrogen requirement and would tolerate poor uniformity of spreading. Traveling distances and transport costs are reduced by high slurry application rates. Spreading rates must be based on satisfying the nitrogen or potash requirements if excess application of fertilizer nutrients was to be avoided. The relative quantities of nitrogen, phosphate and potash varied considerably between different slurry types. The utilization of grass production, either for conservation or grazing, effected the fertilizer recommendations. The tables that were given provided estimates of the nutrient content of the slurries. From these tables, complete details of possible slurry management systems could be worked out with calculators. In the spring and summer months, the timing of slurry application was expected to be the same as grass fertilizer applications. The avoidance of water pollution for wet spring conditions or poor slurry acceptance conditions can also be included in the computer program. A satisfactory management system which meets the grass nutrient requirements and avoids pollution can then be defined for comparison with alternative spreading practices. (Little-East Central)

**5764-A9, A11
THE EFFECT OF FEEDING
DIETS CONTAINING PERMITTED
ANTIBIOTICS ON THE FAECAL
EXCRETION OF SALMONELLA
TYPHIMURIUM BY EXPERIMENTALLY
INFECTED CHICKENS**

Houghton Poultry Research Station, Houghton, Huntingdon PE17 2DA
H.W. Smith and J.F. Tucker
Journal of Hygiene, V. 75, p. 293-301, 1975. 4 tab., 2 ref.

Keywords: Poultry wastes, Bacitracin, Virginiamycin, Flavomycin, Tylosin, Nitrovin, *Salmonella typhimurium*, Excreta, Sulphaquinoxaline, Feed additives, Animal health

The results of examining the faeces of groups of 45 chickens, infected orally with a nalidixic acid resistant mutant of *Salmonella typhimurium*, fed continuously on diets containing 10 or 100 mg./kg. of different 'growth-promoting' antibiotics were given. For culturing the chicken faeces, a brilliant green-agar containing sodium nalidixate and novoblocin was used. In three different experiments, all four groups fed diets containing 100 mg./kg. of nitrovin excreted much larger amounts of *S. typhimurium* than did groups fed antibiotic-free diets. Also, larger amounts were excreted by groups fed diets containing 10 mg./kg. of nitrovin, 10 or 100 mg./kg. of flavomycin or tylosin in some experiments. The amount of *S. typhimurium* excreted was not influenced or only slightly increased by feeding diets containing 10 or 100 mg./kg. of virginiamycin or bacitracin. Smaller amounts of *S. typhimurium* organisms were excreted by two groups fed continuously for 44 days on diets containing 100 or 500 mg./kg. of sulphaquinoxaline than groups fed antibiotic-free diets. (Little-East Central) (British Crown copyright)

5765-A8, B2, D1, E2 EXPERIMENTS ON THE FERTILIZING VALUE OF ANIMAL SLURRIES. PART I. THE USE OF COW SLURRY ON GRASSLAND

N.A.A.S. Yorkshire and Lancashire Region
H.T. Davies
Experimental Husbandry, V. 19, p. 49-60, 1970.

Keywords: Slurries, Cattle wastes, Nitrogen, Land application, Dry matter, Crude protein, Waste composition, Nitrogen, Phosphate, Fertilizer, Potassium

Experiments were conducted from 1964 to 1967 to study the effects of applications of cow slurry to permanent grassland on yields of herbage dry matter and crude protein. The nitrogen content of the slurry caused significant yield increases. Results showed that greater fertilizer value was obtained from applying all the slurry just before growing conditions set in, rather than in increments at intervals during winter. When applied by tanker at about 3,000 gal per acre, the efficiency of nitrogen in the slurry was determined from comparisons of yields obtained with fertilizer nitrogen and analyses of slurry sample. When cow slurry was applied at 12,000 gal per acre, effects on the sward and field drainage water were described. The earlier that slurry is applied in winter the more dependent will available nitrogen for spring growth be on weather conditions. The nitrogen content of herbage was raised less by nitrogen in the slurry than by nitrogen in the fertilizer. (Little-East Central)

5766-B1, B3, C1, C2, C3, D1, D3, E3, F1, F2

ENERGY AND ECONOMIC ASSESSMENT OF ANAEROBIC DIGESTERS AND BIOFUELS FOR RURAL WASTE MANAGEMENT

University of Wisconsin Center, Barron County, Rice Lake, Wisconsin 54868
T.P. Abeles, D.F. Freedman, L.A. DeBaere, and D.A. Ellsworth
Environmental Protection Agency, EPA-R-804-457-010, June, 1978, p. 1-86. 37 fig., 2 tab., 72 ref.

Keywords: Animal wastes, Digesters, Design, Economics, Refeeding, Solid wastes, Anaerobic, Fermentation, Lagoon, Waste management, Biogas, Effluent, Legal aspects, Odor control

Three full scale digesters and one pilot facility were evaluated on the basis of design and operational problems. A beginning assumption was that small digester systems feasibility would transcend the concerns for engineering and chemical design alone. Methods of optimizing engineering and economic feasibility were developed with particular emphasis on technology transfer to the many small to medium sized farms in the Upper Midwest, where the study occurred. Mechanisms which were considered to enhance the attractiveness of these systems included the use of digester effluent for animal refeed and aquaculture or algal farming. Because a combined Municipal Solid Waste (MSW) and animal manure systems could make small or marginal digester systems economical, while at the same time help alleviate rural solid waste problems, the addition of MSW to animal manures for enhancing biogas production was experimented with on a laboratory scale. Socioeconomic research was also conducted to determine the public acceptance of these systems. Institutional, regulatory, and legal factors were examined to ascertain the impact of attitudes and decisions made in these areas on widespread establishment of anaerobic digesters. Characteristics of each site where the digesters were installed, particularly farm energy utilization, were also examined to ascertain the economic trade-offs between using the gas directly for thermal loads or converting to electricity. (Abeles-University of Wisconsin)

5767-B2, B3, C1, C2, C3, D1, D3, E3 ANAEROBIC DIGESTION OF DAIRY COW MANURE PLUS THE ORGANIC FRACTION OF MUNICIPAL SOLID WASTE: A PILOT FEASIBILITY STUDY

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T.P. Abeles, D.F. Freedman, L.A. DeBaere, and D.A. Ellsworth
Environmental Protection Agency, EPA-R-804-457-010, June, 1978, p. 87-114. 9 fig., 13 tab., 26 ref.

Keywords: Cattle wastes, Anaerobic, Digesters, Solid wastes, Methane, Biogas, Mixing, Nitrogen, Chemical oxygen demand, Ammonia, Effluent

Completely mixed and continuously fed laboratory scale anaerobic digesters (operat-

ing on a 18 day SRT) were used to determine the feasibility of producing methane gas from a mixture of dairy cow manure (87% of the total solids) plus the organic fraction of municipal solid waste (33% of the total solids). Biogas production from this mixture was found to be 4.35 ft³/lb VS₅, or 17.7 ft³/lb VS₅. Biogas production from the same set of digesters, run on dairy cow manure alone, was found to be 4.56 ft³/lb VS₅, or 18.2 ft³/lb VS₅. Although the difference in biogas production is slight an analysis of variance showed it to be statistically significant (p 0.0001). Biogas composition from the dairy cow manure plus MSW mixture was found to have a CH₄/CO₂ ratio of 1.23 (~55% CH₄); for the dairy cow manure only phase the CH₄/CO₂ ratio was found to be slightly higher at 1.34 (~57% CH₄). Chemical analyses of the influent and effluent during the dairy cow manure plus MSW phase showed a reduction in total solids of 20.1%, a reduction in volatile solids of 24.6%, a reduction in chemical oxygen demand of 16.7%, and an increase in total Kjeldahl nitrogen (9.1%) and ammonia nitrogen (19.3%). Overall, the anaerobic digestion of a 2:1 mixture of dairy cow manure plus MSW is nearly equivalent to the fact that both dairy cow manure and MSW have a low percentage of readily digestible organic matter; i.e., both are composed of a high percentage of non-solubilized cellulose. (Abeles-University of Wisconsin)

5768-B3, C1, C2, C3, D1, D3, E3, F1 FEASIBILITY OF DEHYDRATING ANAEROBIC DIGESTER EFFLUENT FOR REFEEDING

University of Wisconsin Center, Barron County, Rice Lake, Wisconsin 54868
T.P. Abeles, D.F. Freedman, L.A. DeBaere, and D.A. Ellsworth
Environmental Protection Agency, EPA-R-804-457-010, June, 1978, p. 115-126. 2 fig., 4 tab., 6 ref.

Keywords: Animal wastes, Economics, Refeeding, Waste disposal, Anaerobic, Digesters, Moisture content, Dehydration, Effluent, Ensilage, Nitrogen

Refeeding animal waste is economically attractive. The refeed value of waste is higher than its soil amendment value; it does not change the quality of the manure as fertilizer, and the ultimate disposal is via the soil anyway. The low solids concentration in the effluent from anaerobic digesters prohibits the immediate use of the sludge as a refeed or a feed-ingredient, except as a possible source of food supplement in a watering system as practiced in swine operations. (1) Thus, an economical method of decreasing the moisture content is of prime concern in refeeding anaerobically digested sludge. The preliminary study focused on finding a low-cost filter that could be used on small and intermediate size farms in conjunction with anaerobic digesters. The moisture content should be decreased to a level where the manure can be used as a feed-ingredient or to a level where further dehydrating with other methods, such as heat treatment, would become economically feasible. The figures showed the cost of drying chicken manure at different moisture contents down to 10 percent moisture. The graphs indicated that removing moisture by heat treatment is extremely expensive for mixtures of high moisture content. The moisture content of anaerobically digested manure is approximately 95 percent water. Zero-20 percent moisture removal is necessary before refeeding. (Abeles: Little, ed.)

5769-A11, B3, C1, C2, D3, E3
DIFFERENT LEVELS OF ENSILED AND DEEP STACKED BROILER LITTER FOR GROWING CATTLE

M.D. Hovatter, W. Sheehan, G.P. Dana, J.P. Fontenot, K.E. Webb, Jr., and W.D. Lamm
 Livestock Research Report, Research Division
 Report 175, Virginia Polytechnic Institute and
 State University, July, 1979, p. 77-83. 4 tab.

Keywords: Poultry litter, Refeeding, Ensilage, Sampling, Cattle, Coliforms, Dry matter, Temperature, Performance, Crude protein, Calcium, Phosphorus, Palatability

Broiler litter has been established as a valuable source of protein and minerals for ruminants when processed and fed properly. Processing methods which result in pathogen elimination include heat and chemical treatment and ensiling. Deep stacking broiler litter in a covered structure results in considerable heat production and pathogen elimination, making it a potential processing method that requires a minimum of investment and labor. The optimum moisture for ensiling broiler litter has been shown to be about 40%. Ensilage or deep stacking litter at the time of cleaning poultry houses would result in more flexibility than ensiling the waste with corn forage in the fall. Insufficient data are available concerning the effect of incorporating different levels of broiler litter on performance of growing cattle. A preliminary short term experiment was conducted with cattle fed different levels of deep stacked broiler litter in dry and high silage rations. The results indicated that palatability and performance were quite satisfactory if the level of litter did not exceed 40% of the dry matter. Following this preliminary experiment, an experiment was initiated to study the effect of feeding different levels of deep stacked and ensiled broiler litter in dry ground rations. Changes occurring during deep stacking were also measured. (Hovatter-Virginia Polytechnic Institute and State University)

5770-A11, B3, C2, D3, E3
DIGESTIBILITY AND ACCEPTABILITY OF ENSILED SWINE WASTE AND GROUND CORN GRAIN FOR RUMINANTS

J.C.A. Berger, J.P. Fontenot, E.T. Kornegay, and K.E. Webb, Jr.
 Livestock Research Report, Research Division
 Report 175, Virginia Polytechnic Institute and
 State University, July, 1977. 2 tab.

Keywords: Digestibility, Swine wastes, Palatability, Dry matter, Crude protein, Ensilage, Diets, Nitrogen, Refeeding, Performance

This study was conducted to determine the acceptability and nutritive value of swine waste and ground corn grain mixtures when fed to sheep. The waste was collected from sloped concrete floors at 3-day intervals, mixed with ground corn grain and ensiled in 55-gal steel drums. Ensilage mixtures used in the acceptability and metabolism trials were 60 to 40 and 40 to 60 (swine waste to ground corn grain). Diets for these trials were: (1) basal - 50% corn-SBM (14% protein) and 50% ground mixed hay; (2) 80% basal and 20% of the ensiled 40 to 60 swine waste and ground corn mixture; (3) 80% basal and 20% of the

ensiled 60 to 40 mixture; (4) 60% basal and 40% of the ensiled 40 to 60 mixture; (5) 80% basal and 40% of the ensiled 60 to 40 mixture. The metabolism trial consisted of a 4-day transition, 10-day adaptation, and a 10-day collection period. As the 40 and 60 and 60 to 40 mixtures were increased in the diets, the apparent digestion coefficients increased linearly ($P < .01$) for dry matter, crude protein, organic matter, and NFE. When sheep were fed the 40 to 60 ($P < .01$) and 60 to 40 ($P < .05$) mixtures, the ether extract digestibility increased linearly. The crude fiber and ash digestion coefficients were not noticeably different. The same change was observed in the 40:60 silage but differences were not significant. Nitrogen retention, expressed as g/day and as percent of intake was not significantly different between diets. Dry matter intakes from the palatability trial were given. Lambs fed the basal plus 20% of the 60:40 mixture and basal plus 40% of the 40:60 mixture consumed ($P < .01$) more feed on an actual and expressed as grams $W_{0.75}^{.75}$ /day basis than lambs fed the basal diet. The consumption of the other two diets was intermediate. (Little-East Central)

5771-B3, D2, D3, E3
VARIABLE VELOCITY FLUIDIZED BED FOR PYROLYSIS OF BIOMASS

Department of Chemical Engineering, Texas
 Tech University, Lubbock, TX 79409
 S.R. Beck, W.J. Huffman, U. Mann, and
 H. Wong
 ACS Symposium Series, No. 76, Solid Waste
 and Residues, p. 307-322, 1978. 9 fig., 1 tab.,
 9 ref.

Keywords: Pyrolysis, Biomass, Gasification, Fluidized bed, Cattle wastes, Equipment, Reactor

The pyrolysis in a fluidized bed to produce gas that could be used as fuel or as a feedstock for petrochemical products was studied at Texas Tech University. Processes using fluidized bed technology were in varying stages of development for coal gasification, oil shale gasification, and biomass gasification. Initial fluidization tests were conducted with 1.2 cm styrofoam cubes in the bed. The preliminary results were qualitative, but did indicate that the concept of a three-stage fluidized bed was feasible. A batch of solids was loaded in the bed to a predetermined static bed height to conduct each test. Gradually, the air flow was increased until the bed was fully fluidized and particles began entering the high velocity section of the equipment. This flow was maintained until the lower and upper sections of the bed reached a steady-state solids content. The lower section of the bed behaved as a dense phase, gas-solid fluidized bed. The upper portion of the bed behaved like a sprouting bed with solids moving downward near the wall and being entrained in the center of the bed. This showed that a dense phase, fluidized bed could be supported by a high velocity air stream. Following the styrofoam experiments, manure was placed in the bed. The particles were much smaller, which created many problems. The experiments showed that there was solid circulation from the bottom bed to the top and back to the bottom. This is critical to the reactor because solids are fed to the top of the reactor and must be able to reach the lower section of the reactor in order to react. (Little-East Central)

5772-A5, A7, A10, A11, B2, B3, B5, D3, E2
FARM WASTE DISPOSAL AND ANIMAL HEALTH

M. Hutchison
 Agriculture in Northern Ireland, V. 53, No. 6,
 p. 170-174, Oct., 1978.

Keywords: Waste disposal, Animal health, Slurries, Land application, Farm wastes, Waste storage, Manure pits, Diseases

The fact that infectious diseases can be spread by farm waste should be considered when dealing with the collection, storage, and disposal of manure or slurry. Different ways of spreading diseases are: (1) Grazing - Grazing animals are selective and will not eat grass that has been soiled by manure pats. If slurry is spread on pasture, the grass will be evenly covered and selective grazing becomes impossible. (2) Manure storage - Farms that are heavily stocked can often result in repeated applications of slurry on the same fields at short intervals. This situation presents the danger of diseases being spread throughout the herd. The best precaution is to provide adequate accommodation for slurry storage, sufficient in capacity, and so arranged that no slurry be spread until it has been stored for three months. (3) Spread of infection via polluted water - Slurry seepage into a watercourse can cause infection to be spread to other animals in the herd. (4) Airborne spread - Infected organisms may be suspended in droplets and other particles as the manure is being spread or sprayed over the land. (5) Sharing or borrowing equipment - Machinery is difficult to clean effectively and there are obvious dangers of bringing unwanted infection onto the farm. (6) Storage capacity - Slurry should not be spread until it has been stored for at least three months. Research has also determined the lengths of time over which various diseases producing organisms could survive outside the animal's body after having been passed into manure or slurry. Careful planning of systems and equipment is important in order that associated animal disease risks are kept to a minimum. (Little-East Central)

5773-B3, C1, D1, D3
HYDROGEN SULFIDE AND DIMETHYL SULFIDE IN LIQUID SWINE MANURE

Division of Chemistry and Physics, National
 Institute for Environmental Studies, Yatabe,
 Tsukuba-gun, Ibaraki 300-21 Japan
 A. Yasuhara and K. Fuwa
 Chemosphere, No. 10, p. 833-838, 1978. 4 fig.,
 9 ref.

Keywords: Swine wastes, Liquid wastes, Gas chromatography, Mass spectrometry, Dimethyl sulfide, Hydrogen sulfide

Analytical methods for sulfur-compounds and their formation in liquid swine manure were studied. Two column-packing materials, 25% 1, 2, 3-tris (cyanooxy) propane (TCEP) on Shimadzu and Chromosorb 101 were compared in gas chromatography with flame-photometric detection. Retention times of seven standards were given. Chromosorb 101 gave satisfactory resolution compared with TCEP and was therefore used for characterization while TCEP was used for quantification. Gas chromatography-mass spectrometry for identification

tification of sulfur-compounds was used in the experiment on liquid swine manure. The odorous atmosphere from the liquid manure was passed into the precolumn packed with Tenax GC at room temperature. After heating the precolumn at 250°C for a few minutes, the volatile substances containing sulfur-compounds were injected into the gas chromatograph. Only hydrogen sulfide and dimethyl sulfide were detected in this experiment. Two liters of liquid swine manure were collected into a 3-liter glass bottle and two samples were prepared. A suitable volume of head-space gas over the liquid manure was directly injected into the gas chromatograph with a gas-tight syringe. Nitrogen gas was then passed into sample A for 16 hours at a flow rate of 500 ml/min and air was passed into sample B for 16 hours at a flow rate of 500 ml/min. Gas stripping was used to remove most of the hydrogen sulfide and a particularly remarkable decrease resulted from aeration because of oxidation of hydrogen sulfide. Concentrations of hydrogen sulfide in Sample A and B were about the same as time increased. The dimethyl sulfide in both samples became negligible after gas stripping. It was concluded that the different behavior of dimethyl sulfide may be attributable to the ecological change of the microorganisms. (Little-East Central)

5774-A6, B3, C2, C3, D3, E3 SWINE WASTE MANAGEMENT

Agricultural Engineering Department, The Ohio State University, Columbus, Ohio 43210
E.P. Telgand
Pennsylvania Swine Day, March 4, 1975,
Pennsylvania State University, p. 111-116.

Keywords: Swine wastes, Waste handling, Waste treatment, Odor, Biochemical oxygen demand, Solids separation, Aeration, Aerobic, Oxidation ditch, Effluent, Waste management, Nitrogen, Waste composition, Phosphate, Potash

Studies showed that the handling and treatment of swine waste may be automated with no water pollution and with minimum odor nuisance. For the aerobic treatment unit, the average annual mean BOD removal was 78%. During the summer months, effluent BOD's as low as 24 mg/l were reached. During the winter months the BOD removal was significantly less. The treated effluent still was not suitable to discharge directly into the stream. Its use as recycled flushing water was the key element in the automated system. Odor nuisance was kept at a minimum. The control of odors could be attributable to the regular flushing of wastes from the building and aerobic treatment of these wastes. Tests for ammonia, triethylamine, hydrogen sulfide and other sulfur compounds indicated that these compounds were below odor threshold in the building and near the waste treatment facility. Solids separation was performed with a stationary, run-down screen. Optimum separation was obtained with a wire spacing of 40 mils at 30 gpm. Tests were also conducted for solids separation with a vibrating screen. The vibrating screen improved the removal efficiency slightly but had less capacity. The aeration device provided adequate aeration but did not elevate the temperature of the slurry sufficiently to kill pathogens. The main problems found with the oxidation ditch were freezing during winter weather and foaming. However, these problems were solved. A tertiary treatment using reverse osmosis indicated that effluent of a quality equivalent to potable water could be obtained. This project showed that the unit operations involved may be applied to commercial production operations. (Little-East Central)

5775-A6, B3, C2, C3, D3, E3, F1 FARM-SCALE GENERATION OF BIO-GAS

Department of Agricultural Engineering, University of Minnesota, St. Paul, Minnesota 55810
P.R. Goodrich, R.J. Gustafson, K.L. Hauer, and V. Larson
1978 Midwest Energy Conference, Nov. 19-21, 1978, 30 p. 9 fig., 4 tab., 2 ref.

Keywords: Swine wastes, Methane, Waste handling, Odor, Economics, Anaerobic, Digesters, Biogas, Lagoon, Effluent

A farm-scale research and demonstration digester was constructed, operated and monitored on a private medium-sized swine farm in Minnesota. The feasibility of integrating a methane (bio-gas) powered electrical generator into an electrical distribution system was studied. Materials handling problems existed for moving the solids into the digester. The digester only produced enough energy to replace \$1.00 worth of other energy per day. Benefits such as odor control, pollution control and nutrient conservation must help to justify the cost of the digester. This research digester can serve as a base line to design more efficient and practical systems. (Little-East Central)

5776-C2 VARIABILITY OF E. COLI LEVELS IN BOVINE FECES AND ITS IMPLICATION ON GUIDELINES FOR GROUND BEEF

Canada Packers Limited, Research Centre, 2211 St. Clair Avenue West, M6N 1K4
C.M. Davidson and M. Taylor
Canadian Institute of Food Science and Technology Journal, V. 11, No. 1, January 1978, p. 53. 1 tab., 3 ref.

Keywords: *E. coli*, Cattle wastes Contamination, Waste handling, Sampling

E. coli levels present in 50 samples of freshly voided bovine feces were studied. The samples of feces were obtained from cattle holding pens, over a three-month period. Ten grams of each sample were blended with 90 ml of 0.1% peptone water. Tenfold serial dilutions were made in 0.1% peptone water. Also three of the 50 samples were checked for *E. coli* level using a 3-tube MPN technique. The results showed that the *E. coli* level ranged from $< 10^2$ g to $> 10^7$ g with 56% falling between 10^5 and 10^7 g. The geometric mean of the samples was 8.6×10^3 g. The MPN data on the 3 samples agreed with those obtained by the direct plating method. It was found that after slaughter and dressing, two carcasses may have the same degree of fecal contamination and yet have different *E. coli* levels. Results suggested that *E. coli* is not a perfect indicator of fecal contamination of fresh beef, because of the variability in counts in bovine feces. However *E. coli* will be used for indicating care in slaughter and handling until a better indicator of fecal contamination is found. (Little-East Central)

5777-F2 AFFCO APPROVES ADOPTION OF DRIED POULTRY WASTE REGULATION

Feedstuffs - Staff Editor

R. Leidahl
Feedstuffs, V. 51, No. 33, p. 2, August 13, 1979.

Keywords: Poultry wastes-dried, Legal aspects

The Association of American Feed Control Officials (AFFCO) approved adoption of a dried poultry waste model regulation. The main point of controversy was disagreement whether the definition should be allowed since it appeared to some members to be in conflict with adulteration provisions of the Uniform Feed Bill. It was felt that the establishment of an AAFCO model could lend some uniformity in formation of the regulations. (Little-East Central)

5778-D3, E3 FARMERS DEVELOP TECHNOLOGY TO TAP ENERGY FROM WASTE, RENEWABLE RESOURCES

Anonymous
Big Farmer, August, 1979, p.7

Keywords: Energy, Biomass

Today, there is a new wave of technology spreading throughout the United States. Private industrialists, universities, retired engineers and farmers, have discovered what may be a major technological breakthrough in the conversion of biomass to energy. President Carter has recommended to Congress an appropriation of \$57.8 million for further development of biomass conversion. Purdue University, West Lafayette, Indiana recently held a workshop where all concerned people joined together in an effort to get biomass conversion into high gear as quickly as possible. They drew up a list of recommendations for any roadblocks that might arise. (Little-East Central)

5779-A11, B3, C2, D1, E3 UTILIZATION BY RATS OF PROTEINS IN PIG FAECES RELATIVE TO BARLEY AND FORTIFIED CASEIN PROTEINS

Department of Physiology and Chemistry, Agricultural Research Laboratory, Copenhagen, Denmark

B.O. Eggum and K.D. Christensen
Agriculture and Environment, V. 1, p. 59-64, 1974. 2 fig., 3 tab., 5 ref.

Keywords: Swine wastes, Amino acids, Rats, Nitrogen, Waste composition, Phosphorus, Calcium, Magnesium, Iron, Zinc, Sodium, Performance, Dehydration, Refeeding

The nutritional value of pig faeces was examined by indirect and direct methods. Examination of the protein quality showed that the protein content was relatively high - c. 22% of dry matter. In addition, the amino acid analyses of faecal protein showed that the content of several amino acids was much higher than in barley protein. This was particularly so for lysine, threonine, methionine and isoleucine. Experiments with rats

showed that approximately 60% of the protein in pig faeces was biologically available, and that this protein had a biological value of c. 70%. Utilizable nitrogen in pig faeces could be estimated to 1.4% while the corresponding value of barley was only 1.1%, i.e., a difference of approximately 25%. (Eggum-Agricultural Research Laboratory)

5780-B3, C2, D3 NAOH-TREATED WASTELAGE LOWERS PROTEIN DIGESTIBILITY

Anonymous
Feedstuffs, V. 51, No. 32, p. 14-16, August 6, 1979.

Keywords: Cattle wastes, Sodium hydroxide, Crude fiber, Digestibility, Ensilage, pH, Refeeding, Silos, Feed additive

In a study at Virginia Polytechnic Institute and State University, treatment of rations comprised of cattle waste and rye straw with sodium hydroxide increased in vivo dry matter, organic matter and crude fiber digestibility compared with untreated wastelage rations. The NaOH treatment decreased crude protein digestibility. Before ensiling, the addition of NaOH increased the pH of the material and may have helped in the elimination of pathogenic organisms. Cattle waste and ground rye straw were mixed in a 60:40 ratio, wet basis. Two types of cattle waste were used: (1) high-roughage waste from animals that were fed a full feed of corn silage with 2 lb. soybean meal per head per day, and (2) high-concentrate waste from animals fed a full feed of cracked corn grain plus 10 lb. of corn silage and 2 lb. soybean meal per head per day. The 60:40 wastelages were adjusted to DM of 30, 40 or 50% with water and treated with either 0 or 4% NaOH, dry basis. The mixtures were ensiled in laboratory silos for a minimum of 42 days. In vitro digestibility was determined on the wastelages. As a result of these tests six wastelages and a control diet were selected for use in a lamb metabolism study. (Little-East Central)

5781-B2, B3, C1, C3, D3, E3, E4, F1 MAKING METHANE FROM MANURE

J. Odle
Progressive Farmer, V. 94, No. 7, July, 1979, p. 48, 49.

Keywords: Methane, Cattle wastes, Energy, Land application, Refeeding, Slurries, Digesters, Economics

Thermonetics, Inc., of Oklahoma City has built a 500-ton (manure) capacity methane plant adjacent to the 75,000-head Masters Feedlot near Guymon, Oklahoma. The methane produced by the plant, 1.6 million cubic feet daily, is shipped by an interstate natural gas pipeline to Chicago to heat homes. Enough

methane was produced to heat 3,500 homes. The feed supplement is fed to cattle, and the liquid waste is spread on farmland. Thermonetics purchases manure for \$2 to \$3 per ton and sells its methane gas at a price competitive with natural gas. Don Kaplan, of Kaplan Industries also has a methane facility. However, Kaplan uses fresh manure. Kaplan's methane digester operates at a higher temperature than the Thermonetic's digester - 135°F, versus 95°F. The methane will replace 6,000 gallons of fuel oil that the packing plant uses daily. The total amount of electricity these generators provide will be equal to the energy output of a small rural substation. University of Missouri scientists have been operating a small methane plant since 1976. The unit produces 2,000 cubic feet of methane per day with a capacity of up to 10,000 cubic feet daily. It would provide enough energy to heat the hog houses during winter, and, by adding an electrical conversion system, cool the houses during the summer. Other promising projects were also discussed. (Little-East Central)

5782-B1, B2, C3, D3, E4 STAGED LAGOON TREATMENT OF FEEDLOT WASTE

University of Missouri, Rolla, Missouri 65401
S.G. Grigoropoulos and A.H. Loudermilk, Jr.
Journal Water Pollution Control Federation, V. 51, No. 1, p. 163-175, Jan., 1979. 4 tab., 16 ref.

Keywords: Swine wastes, Waste treatment, Lagoons Anaerobic, Aerobic, Collection pits, Chemical oxygen demand, Methane, Design, Effluent, Biochemical oxygen demand, Kjeldahl nitrogen, Phosphorus

A study was conducted to characterize swine waste collected under a slotted feeding floor using a water carriage system, and to evaluate the treatment of this waste in a staged lagoon system consisting of an anaerobic, a dual anaerobic/aerobic, and an aerobic lagoon. A small feeding floor, which could hold three groups of animals, and a pilot three-lagoon system were designed, constructed, and tested. The floor was equipped with collection pits which held the waste and sufficient dilution water to suppress odors and facilitate waste removal. Three different feed rations were fed to the animals, ranging from a simple to a complete mix. The different feeds had no appreciable effect on most of the characteristics of the swine waste, but did affect its settleability, which resulted in a variation in supernatant characteristics. The volume of the fluidized waste averaged 54.9 1/d (14.5 gal/day) per animal and had the following characteristics, expressed in mg/l: TS 6,200; VS 4,800; COD 9,000; BOD 3,200; total Kjeldahl nitrogen 890; total P 60; and grease 310. Potential advantages involve the production of energy by the recovery of methane released in the anaerobic lagoon, fertilizer value of the digested sludge, and production of animal feed by the harvesting of algae. (Little-East Central)

5783-A11, D3, E3 ENSILED CORN FORAGE AND BROILER LITTER AND ZERANOL IMPLANT FOR FINISHING HEIFERS

Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
W.H. McClure, J.P. Fontenot, and K.E. Webb, Jr.
Livestock Research Report 175, Virginia Polytechnic Institute and State University, July, 1977, p. 69-76. 5 tab.

Keywords: Poultry wastes, Ensilage, Zeranol, Refeeding, Cattle, Silages, Crude protein, Nitrogen, Economics, Palatability, Performance, Carcass quality

Weanling calves can be finished on a ration of high quality corn silage, limited grain and protein supplement. Broiler litter contains about 30% crude protein, dry basis, and the nitrogen is efficiently utilized by ruminants. One promising method of using broiler litter is to ensile it with corn forage, and good ensiling occurs when 30% broiler litter, dry basis, is mixed with corn forage at ensiling time. A three-year study was started in 1975 and concluded in 1978 to study the performance of fattening heifers fed corn silage or corn-litter silage, and 1% bodyweight of concentrates with or without soybean meal supplementation. Implanting growing and finishing cattle with zeranol (trade name: Raigro) has been shown to result in increased rate and efficiency of gain. During the last year (1977-78) of the trial the effect of the zeranol implants was studied in cattle fed rations with and without broiler litter. (McClure-Virginia Polytechnic Institute and State University)

5784-A6, B2, F2 STATE MAY DROP ODOR RULES FOR LAGOONS

Anonymous
Wallaces Farmer, V. 104, No. 15, p. 10, August 11, 1979

Keywords: Odor control, Lagoons, Legal aspects

The Iowa Air Quality Commission is considering changing or possibly even dropping its rules for current lagoon odor. Charlie Miller, director of the Air Quality Commission told commissioners they had two alternatives: (1) Solicit additional information up to September 13 and hope that some answers were forthcoming, or (2) Drop the rules altogether and stop issuing permits. Livestock and farm groups never agreed to all the standards currently in the state rules for new lagoon construction - especially the siting requirement. Livestock interests took their concerns to the Iowa legislature who promptly cut the separation distances in half. Riley Cook, a Nebraskan speaking for a building company specializing in building large hog complexes told commissioners that their lagoon rules had virtually eliminated Iowa as a place for building large hog facilities. (Little-East Central)

5785-A6, A8, B2, E2, F1 THE ECONOMICS OF MANURE INJECTORS

E.C. Dickey
Dairy Herd Management, V. 15, No. 5, p. 64, 67, 1978.

Keywords: Odor, Nitrogen, Volatilization, Liquid manure, Injection, Equipment-inject-

ors, Nitrogen, Land application, Economics, Odor control

Injecting liquid manure underground reduces odor problems and loss of nitrogen by volatilization. Purdue University agricultural engineers calculated the additional power required when an injection system was used instead of surface spreading. For injection at a depth of 8 in. and a speed of 4 mph, an additional 18 hp. was needed per chisel. The additional power costs \$1.44/chisel/hour of use, using an average tractor cost of \$0.06/hp./hour. Using an injector set-up with two chisels, the system cost an additional \$2.88/hour of use. At an unloading rate of 250 gal./minute, 1,000 gal. could be unloaded in 4 minutes. The cost of the additional power was then \$0.19 per 1,000 gal. of manure injected [$(\$2.88 \times 4) - \$0.1$]. The price of injection systems using two chisels was about \$1,550. The cost to inject 1,000 gal. of liquid manure was \$0.19 (power cost) + \$0.70 (operating cost) = \$0.89. The volatilized nitrogen loss from surface spreading would be \$1.55/1,000 gal. of dairy manure. Injection will have about a 5% volatilization loss at a value of \$0.26/1,000 gal. The value of the nitrogen saved would be the difference between the two volatilization losses, of \$1.29/1,000 gal. The advantages of an injection system makes this the preferred system for liquid disposal when conditions permit. (Little-East Central)

5786-B2, C1, C2, C3, D2, D3, E3, F1

CONTINUOUS AEROBIC CONVERSION OF POULTRY WASTE INTO SINGLE CELL PROTEIN USING A SINGLE CELL REACTOR: KINETIC ANALYSIS AND DETERMINATION OF OPTIMAL CONDITIONS

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F. Kargi, M.L. Shuler, R. Vashon, H.W. Seeley, Jr., A. Henry, and R.E. Austic
Final Report "Controlled Microbial Conversion of Poultry Waste into A High Protein Feedstuff", Jan. 31, 1979, 29 p. 12 fig., 6 tab., 29 ref.

Keywords: Aerobic conversion, Poultry waste, Single cell protein, Reactor, Kinetics, Slurries, Molasses, Design, Temperature, pH, Uric acid, Ammonia, Nitrogen, Amino acids, Refeeding, Fermentation, Economics

A single stage aerobic continuous process for the conversion of poultry waste into single-cell protein is described. The slurried manure was supplemented by molasses. Kinetics and possible mechanisms for the suggested conversion scheme have been investigated. A Box-Wilson experimental design has been employed to elucidate the effect of environmental conditions on reactor performance. Temperature, pH, and percent solids concentration in the feed (media composition) were the independent process variables, while the minimum residence time for the nearly complete utilization of total uric acid and ammonia nitrogen, the amount of carbon required per gram of nitrogen consumed, and protein content of the product were considered as dependent variables. Optimal environmental conditions for the minimum raw material cost was found to be 25°C, pH 7.5, and 1.4 percent solids in the feed with a residence time of 8.0 hours. Under these

operating conditions the product has 56 percent protein and very attractive amino acid profile which may give the product sufficient value to be economically competitive with other animal feedstuffs. (Shuler-Cornell University)

5787-B2, D1, D2

AN EVALUATION OF VARIOUS FLOCCULANTS FOR THE RECOVERY OF BIOMASS GROWN ON POULTRY WASTE

School of Chemical Engineering and Institute of Food Science, Cornell University, Ithaca, New York 14853
F. Kargi and M.L. Shuler

Final Report "Controlled Microbial Conversion of Poultry Waste into A High Protein Feedstuff", Jan. 31, 1979, 17 p. 5 fig., 1 tab., 22 ref.

Keywords: Flocculation, Biomass, Poultry wastes, Single cell protein, Aerobic, Molasses, Refeeding, pH, Calcium hydroxide, Economics, Slurries, Dilution, Flocculants, Centrifugation

Mixed bacterial cultures were grown aerobically in continuous culture with poultry manure and molasses as substrates. The single-cell protein (scp) product is intended for use as high-protein feedstuff for animals, particularly poultry. An economically attractive scp recovery process must be developed if such a conversion process is to prove to be commercially viable. The recovery of scp by centrifugation alone is difficult. In an attempt to achieve enhanced scp recovery at lower cost a number of inorganic and polymeric flocculants were tested over a wide range of pH values and dosages. The rate of flocculation and degree of solids recovery were criteria used for the selection of a flocculant. Calcium hydroxide was the most effective flocculant. A dosage of 20 mg/l at pH values between 10 and 12 gave excellent results. Increasing the dosage of calcium hydroxide beyond 20 ppm did not effect the flocculation rate. (Shuler-Cornell University)

5788-A8, B3, B5, C1, C3, D1, E2

PHYSICAL CONDITION OF A DAVIDSON CLAY LOAM AFTER FIVE YEARS OF HEAVY POULTRY MANURE APPLICATIONS

Department of Agronomy, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
R.R. Weil and W. Kroontje
Journal of Environmental Quality, V. 8, No. 3, p. 387-392, 1979. 5 fig., 3 tab., 24 ref.

Keywords: Land application, Aggregates, Poultry wastes, Infiltration, Moisture content, Bulk density, Soils, Physical properties, Earthworms, Soil conditioning

Little information is available on how soil physical properties are affected by very heavy poultry manure applications often associated with concentrated poultry production. In this study, after 5 years of applying up to 110 metric tons of poultry manure/ha per year to corn plots, the physical condition of the

manured plots differed markedly from that of the unmanured controls. During the spring the activity of soil invertebrates created a highly channelized and aggregated structure in the surface soil. Plowlayer bulk density was reduced by the poultry manure from 1.1 to 0.8 g/cm³ and the percentage water-stable aggregates increased from 73 to nearly 94%. About half of the variability in bulk density could be accounted for by differences in soil organic matter contents. The manured plots were generally more moist in the plow layer, especially in spring and early summer when a perched water table at a depth of 20 cm was caused by a water-repellant plowsole layer of partially decomposed manure. In the spring this layer resulted in infiltration rates on the manured plots as low as 0.02 cm/hour compared to a mean of 12.1 cm/hour on the controls. In November, the infiltration rate of the manured plots rose to 57 cm/hour due to the activities of earthworms. The manured plots held nearly 42% moisture at 0.1 bar tension as compared to 32% for the control plots. Incorporation of poultry manure by means other than moldboard plowing might avoid the creation of a plowsole manure layer which counteracts the potentially beneficial effects of the manure on soil structure and water-holding capacity. (Weil-Virginia Polytechnic Institute and State University)

5789-A8, B2, B3, C1, C2, D1, E2

FARM WASTE MANAGEMENT: BARRIER DITCHES

Ministry of Agriculture, Fisheries and Food, Agricultural Development and Advisory Service
Agricultural Development and Advisory Service
Short Term Leaflet 172, 1976, 8 p. 5 fig.

Keywords: Barrier ditches, Cattle wastes, Suspended solids, Soils, Drainage, Biochemical oxygen demand, Waste management, Settling, Effluent, Design

The barrier ditch system consists of a primary settlement tank, in which gross solids can settle, followed by a ditch with barriers which divide the ditch into several sections and hinder the flow of liquid. The purpose of the barrier sections is to promote maximum settlement of suspended solids and to allow biological breakdown of organic matter to proceed anaerobically. Clean surface water should not be piped to the barrier sections. The site for the barrier ditch system must be able to accommodate a ditch of ample capacity required to retain the carefully estimated amount of farm effluent for a holding period of as long as possible and at least 60 days. To allow effluent to flow by gravity from one section of the ditch to the next, reasonable landfall is also required. Soil type and the depth of the water table are also important considerations. If there is good separation of solid manure from the liquid waste, the efficiency of the system is greater. The barrier sections need to be of sufficient capacity to retain effluent for at least 60 days and preferably more, and the system should have the maximum length of free flowing ditch available, with a minimum of 300 metres prior to final discharge. The size of the barrier ditch depends on the amount of washing water from parlour and milking plant, dairy washings and drainage from fouled open concrete yard areas. It is not recommended that drainage from livestock housing and liquid seepage from a manure compound be included for treatment because of its potentially high BOD. particularly if it is contaminated with silage. A high standard of construction is essential.

Barrier ditches must be securely fenced with child-proof fencing. A barrier ditch is not recommended unless good management of it can be guaranteed. The barrier sections, especially the first one, should be de-sludged annually. A neglected barrier ditch can soon lose its efficiency and become useless. (Little-East Central)

5790-A11, B1, B4, C1, D2, D3, E3 THE TRANSFER OF THE COCCIDIOSTAT CLOPIDOL TO LAMBS BY FEEDING CHICKEN WASTE

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J.J. Ryan, J.C. Pilon, H.A. McLeod, D.C. Crober, and A.E. Sefton
Journal of Environmental Quality, V. 8, No. 3, p. 439-442, 1979. 3 tab., 9 ref.

Keywords: Poultry wastes, Recycling, Clopidol, Lambs, Ensilage, Carcass quality, Sampling, Hydrolysis, Gas chromatography, Animal health, Moisture content, Fermentation, Waste storage

Broiler chickens of both sexes were fed a diet with and without 125 µg/g of the coccidiostat clopidol (3,5-dichloro-2, 6-dimethyl-4-pyridinol). The waste from these animals was fermented with a wood base and fed to lambs for a 5-mo period. The clopidol in the lamb feed, the edible tissues, and faeces was measured at slaughter by gas chromatography (GC) with electron capture (EC) detection and confirmed by mass spectrometry (MS). Lamb silage from chicken waste contained 70 to 80 µg/g clopidol. Kidney levels of treated groups averaged between 0.4 to 0.75 µg/g, while those in liver were 0.2 to 0.4 µg/g. Muscle and fat tissue contained 0.1 to 0.5 and 0.2 to 0.8 µg/g. An additional 10 to 30% more clopidol was present in the kidney, liver, and blood but not the faeces in the form of the glucuronide conjugate. Clopidol was passed on from the chickens to the lambs by feeding of chicken waste but did not appear to accumulate in the lambs. (Ryan-Health Protection Branch)

5791-B1, C1, C2, D1, D2, E3 THE POSSIBILITY OF PRODUCING TUBERCULIN SENSITIVITY BY FEEDING POULTRY LITTER

Animal Pathology Division, Health of Animals Branch, Canada Department of Agriculture, Animal Diseases Research Institute, P.O. Box 490, Hull, Quebec

J.A.J. Carriere, D.C. Alexander, and K.A. McKay
Canadian Veterinary Journal, V. 9, No. 8, p. 178-185, 1988.

Keywords: Poultry wastes, pH, Mycobacteria, Guinea pigs, Moisture content, Refeeding

Experiments were conducted on 29 samples of poultry litter to determine the length of time that known cultures of different mycobacteria would survive in poultry litter. Microscopic evidence of the presence of mycobacteria was observed in eight of the samples. In two samples, atypical mycobacteria were recovered. From a strain of *M. avium*, viability tests were conducted in viable and non-viable poultry litter obtained from the field. The test

organism had a longer survival time in the sterilized litter than it did in the untreated litter. Factors influencing survival such as the pH and competing litter microflora were discussed. It was found that from the various tuberculin prepared and tested by the comparative intradermal test, that the live Runyon IV strain sensitized guinea pigs to these tuberculin. It was suggested that this strain may have some future merit in the preparation of a diagnostic tool to aid in the diagnosis of tuberculosis caused by atypical mycobacteria as well as John's disease. The danger that may be inherent when poultry litter is fed to ruminants was discussed. (Little-East Central)

5792-A8, B3, C2, E2 EFFECTS OF HEAVY APPLICATION OF CATTLE SLURRY ON YIELD AND QUALITY OF PASTURAGES

Department of Animal Husbandry, Hiroshima University, Fukuyama, Japan

S. Ogata, E. Matsui, and T. Ando
Proceedings International Seminar on Soil Environment, Fertilizer Management, and Intensive Agriculture, 1977, p. 698-703. 3 fig., 4 tab., 4 ref.

Keywords: Cattle wastes, Slurries, Soils, Land application, Crop response, Potassium, Calcium Phosphorus, Magnesium, Application rates, Nitrate, Soils, Fertilizers, Waste composition, Dry matter, Nitrogen, Soil chemistry

A study was conducted to investigate the effects of heavy application of slurry of dairy cattle waste on yield and mineral quality of sweet sorghum (*Sorghum vulgare*) (SS) and Italian ryegrass (*Lolium multiflorum*) (IR) grown in field experiments from 1972-1974. The heavy application of cattle slurry up to 45 and 90 tons/10a/year increased remarkably dry matter production of IR and SS, respectively. On yields of both herbage, the beneficial effects of slurry application were more apparent on the virgin soil than on the cultivated soil. Potassium accumulated in the soils from such a heavy application of slurry. This resulted in high K/(Ca-Mg) in herbage, especially in IR. The nitrate content of herbage also increased and exceeded the probable toxic level of nitrate. From the results of some pot-culture experiments, the way to solve the problems accompanying heavy application of slurry were discussed. (Little-East Central)

5793-C1, C2, C3, D3, E3, F1 METHANE GAS PRODUCTION FROM SWINE MANURE

University of Manitoba, Canada

D.D. Schulte
Proceedings of Alberta Pork Seminar, University of Alberta Faculty of Extension, 1978, p. 87-101. 4 tab., 13 ref.

Keywords: Biogas, Swine wastes, Anaerobic digestion, Economics, Waste handling, Methane, Temperature, Digesters, Ammonia, Nitrogen, Gas storage

Pork producers are interested in learning more about (1) biogas production from manure, (2) technical factors involved and (3) cost of the process. Biogas production from animal manure is possible by anaerobic digestion. This is a biological process which

uses bacteria to break down the organic matter contained in the manure. The most practical digesters operate between 25° and 35°C (77° and 95°F). The performance of swine manure digesters are affected by mixing, the presence of toxic substances, and the age and quality of the manure. When assessing the technical feasibility of anaerobic digestion for farm application, three factors must be considered: (1) manure handling, (2) biological process-stability, and (3) gas handling. Estimates of the economic feasibility of conversion of manure to methane gas vary widely depending principally on the sophistication of process monitoring and the manure and gas handling equipment assumed necessary for the design and on the assumed process performance. However, as energy costs increase and low-cost methods of utilization and biogas storage are developed, methane production will become economically feasible for many swine producers. (Little-East Central)

5794-A6, B3, C3, D3, F1 THE OXIDATION DITCH AS A DAIRY CATTLE WASTE MANAGEMENT ALTERNATIVE

Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853
J.H. Martin, R.C. Loehr, and R.J. Cummings
Agricultural Waste Management, July 27, 1978, 78 p. 27 fig., 31 tab., 18 ref.

Keywords: Cattle wastes, Oxidation ditch, Aerobic, Economics, Odor control, Waste handling, Fly control, Waste management

This study was conducted to delineate the biological and physical operating characteristics of the oxidation ditch as a dairy cattle waste management alternative in order to identify optimal design and operating parameters. Other objectives included determinations of: (1) Dairy cattle manure production rates and characteristics, (2) Aerobic treatability of dairy cattle manure, (3) Biological and physical operating characteristics of full-scale systems and (4) System economics. The study showed that the oxidation ditch was a feasible dairy cattle alternative which was capable of providing odor control, abatement of fly problems, and waste stabilization. Process design parameters for the systems were given. The most significant operational problem identified in this study was the accumulation of residual solids which resulted in a linear increase in mixed liquor total solids (MLTS) concentration. Further MLTS increase resulted in significant decreases in mixed liquor velocity and dissolved oxygen concentration, above a MLTS concentration of 40 gm/l. This necessitated periodic removal of the ditch contents which was a major factor in the ultimate disposal requirements associated with this approach. There was a significant increase economically, in waste management cost from the use of the oxidation ditch for dairy cattle wastes as compared to waste handling systems such as an alley scraper. However, the higher cost of an oxidation ditch must be considered in the context of the added benefits of odor control, fly control, and waste stabilization for which no economic benefit was assigned in this study. (Little-East Central)

5795-A11, B3, C2, E3
ENERGY, PROTEIN AND MINERAL VALUE OF DRIED POULTRY MANURE FOR SHEEP

Department of Animal Husbandry, University of Helsinki, 00710 Helsinki, Finland
 M. Salo, M. Suviola, and M. Näsä
 Journal of the Scientific Agricultural Society of Finland, V. 47, p. 462-468, 1975. 5 tab., 13 ref.

Keywords: Poultry waste-dried, Sheep, Protein, Energy, Digestibility, Nitrogen, Dry matter, Diets, Crude protein

The energy, protein and mineral value of the dried manure of laying battery hens (DPM) was investigated in digestibility and balance trials with four adult sheep. The basal diet consisted of barley meal and straw supplemented with vitamins and minerals. In one of the two trials 13% of DPM, with a nitrogen content of 6.7% of dry matter, was incorporated into the diet. The intake of energy corresponded to the maintenance requirement. In the DPM diet the intake of crude protein and some minerals exceeded the requirement. The digestibility of the organic matter of DPM, calculated by the difference method, was 62.6% and that of total nitrogen 88.4%. The energy value was 1.56 Mcal. ME or 0.47 F.U. (F.U. = 0.7 starch units) per kg dry matter, and the nitrogen value 650 g DCP per F.U. The animals were in balance in respect to nitrogen and most of the minerals, and no obvious differences were found between the diets. (Salo-University of Helsinki)

5796-A11, B1, B3, C1, D1, D2, E3, F1
NUTRITIVE VALUE OF CHICKEN MANURE OR HOG MANURE FERMENTATIVE FEED IN DIETS FOR THE GROWING-FATTENING PIGS

Department of Agriculture and Forestry, Taiwan Provincial Government, Taiwan
 P.K. Lee
 Taiwan Agriculture Quarterly, V. 13, No. 2, p. 188-203, June, 1977.

Keywords: Poultry wastes, Swine wastes, Diets, Refeeding, Swine, Performance, Fermentation, Carcass quality, Moisture content, Dehydration, Temperature, Economics

The use of chicken manure or hog manure as a part of feed in chicken or swine diets has been conducted by the author since 1955 with good results. Five percent of processed chicken manure may be used in chicken or swine diets with beneficial effects on its performance. The purpose of this study was to determine the nutritive value of chicken manure or hog manure fermentative feed in diets for the growing-fattening pigs. The chicken manure or hog manure fermentative feed was prepared by 60 percent of the fresh chicken manure or hog manure, 20 percent of the green sweet potato vines and 20 percent of rice bran with some water till 50 percent moisture content of the mixture and had been kept at room temperature for about 5 days and dried prior to the feeding test. Four litters of 24 male crossbred weaning pigs averaging 24 kg. in weight were divided into three treatments on the basis of litter and body weight of 8 heads

for each treatment. Treatment A received corn-soybean basal diet for controls, Treatment B. Basal diet 90% + Chicken manure fermentative feed 10% while Treatment C. Basal diet 90% + Hog manure fermentative feed 10%. The pigs were housed on concrete-floored individual pens. Diets were given twice daily individually according to the scale feeding system and allowed free access to water at all time. Body weight and feed consumption records for each pig were kept at the intervals of 20 days throughout 100 days of the feeding trial. At the completion of the feeding trial, one half of the pigs from each of the three treatments were slaughtered for carcass study. The chemical composition of the two experimental manure fermentative feeds were also determined. It indicated that the average weight gains, feed conversion rate of the pigs at the end of the feeding trial, the average dressing percentage, backfat thickness, lean loin eye area, moisture, crude protein, crude fat, crude ash contents of the longissimus muscle for the pigs of the treatment A were 69.43 kg, 3.729, 75.16%, 3.49%, 3.617 cm., 27.350 cm., 74.65%, 19.24%, 1.20%; for the treatment B were 67.80 kg, 3.835, 74.72%, 3.450 cm., 26.520 cm., 70.74%, 19.79%, 3.73%, 1.31% while for the treatment C were 67.03 kg, 3.825, 75.95%, 3.465 cm., 27.175 cm., 70.56%, 20.07%, 3.61%, 1.27% respectively. The analysis of variance of the above said determinations among the three treatments all showed no significant difference. It also indicated that the growth and feed conversion rate of the pigs at the first 20 days of the feeding trial were improved when the pigs received either the chicken manure or the hog manure fermentative feed in their diet. The carcass grade of the pigs also seemed to be improved when the pigs fed the diet containing the hog manure fermentative feed. The feeding cost of the pigs could be much reduced when the growing-fattening pigs had received either the chicken manure or the hog manure fermentative feed. (Lee; Little, ed.) (Abstract Only)

5797-A11, B1, B3, C2, D1, E3
DIGESTIBILITY BY CATTLE OF DIETS CONTAINING DRIED PIG FAECES

School of Agriculture and Forestry, University of Melbourne, Parkville, Victoria, 3052 Australia
 G. Stanogias and G.R. Pearce
 Animal Feed Science and Technology, V. 3, No. 2, p. 155-161, 1978. 3 tab., 24 ref.

Keywords: Digestibility, Diets, Swine waste-dried, Performance, Recycling, Nitrogen, Copper, Animal health, Design, Dehydration, Crude protein

The apparent digestibility of diets in which dried pig faeces replaced 0, 15, 30, and 45% of hay (diets A, B, C and D, respectively) was compared using four steers in an experiment of 4 x 4 Latin square design. All rations were readily consumed and no undesirable effect on animal health was observed. Each increase in the proportion of pig faeces in the diet reduced the apparent digestibility of the dietary components. The dry matter digestibility of diets A, B, C and D was 57.9, 52.4, 50.0 and 44.5%, respectively. Similar reductions occurred in the apparent digestibility of crude protein, crude fibre, ether extract and nitrogen-free extract. (Stanogias-University of Melbourne)

5798-A11, B1, B3, B4, C1, C2, C3, D1, D3
EFFECT OF DIETARY ARSONIC ACIDS ON FRESH SWINE WASTE COMPOSITION AND ANAEROBIC DECOMPOSITION

Purdue University, West Lafayette, Indiana 47907
 M.C. Brumm, A.L. Sutton, V.B. Mayroae, and J.L. Krider
 Journal of Animal Science, V. 48, No. 6, p. 1305-1311, 1979. 4 fig., 7 tab., 15 ref.

Keywords: Arsenic, Arsonic acids, Swine waste, Anaerobic decomposition, Waste composition, Diets, Manure pit, Waste storage, Anaerobic, Waste collection, Sampling, pH, Kjeldahl nitrogen, Dry matter, Volatile solids, Ash, Nitrogen, Model

A complete random design experiment was conducted to determine the effect of dietary arsonic acids on swine waste composition and decomposition in anaerobic pits. Vitamin and mineral fortified corn-soybean meal basal diets with either 75 ppm roxarsone or 100 ppm arsonic acid were fed to growing-finishing pigs (14 to 91 kg) with daily fresh waste collection and addition to model anaerobic pits. Arsonic acids in the diet influenced ($P < .001$) pH, dry matter, volatile solids, Kjeldahl nitrogen, ammonium nitrogen and arsenic content in the model anaerobic pits. Compared to the control there was a significant decrease in dry matter and volatile solids. Arsonic acid in the diet increased ($P < .001$) the amount of nitrogen in the ammonium form compared to the control and roxarsone diet. Arsonic acid increased ($P < .05$) the acetic acid content in the anaerobic pit compared to the control when expressed as a percentage of total volatile fatty acids measured. Elemental arsenic losses to the atmosphere were measured in anaerobically stored waste from all treatments. (Brumm-Purdue University)

5799-A6, B3, C1, C2, D1, E3
ODOURLESS DRYING OF FOOD PRODUCTION AND PROCESSING WASTES

School of Engineering, University of Guelph, Guelph, Ontario
 A.G. Meiering, F.B. Heese, and J. Pos
 Paper No. 73-210, Canadian Society of Agricultural Engineers, Victoria, British Columbia, Canada, Aug. 21, 1973. 9 fig., 11 ref.

Keywords: Dehydration, Odor control, Poultry waste-dried, Sheep waste-dried, Potato processing wastes, Refeeding, Fertilizers, Design

A pilot scale odour-free waste drying system consisting of a continuous flow drying unit, afterburner and heat exchanger was developed and its performance analyzed at the Waste Research Station at the University of Guelph. The exhaust air from the dryer entered an afterburner, where odorous compounds and dust were oxidized by open flame combustion at 650°C. Complete odour elimination, except for traces of ammonia were achieved in the drying of poultry and sheep manure as well as potato processing wastes generated in caustic soda and mechanical peeling processes. Nearly 60 percent of the heat generated in this process was recovered by heat exchanger for

the drying, which required about 1200 Kcal per kg water evaporated. Temperatures and moisture contents of the drying air and the waste evaporated. Temperatures and moisture contents of the drying air and the waste materials were monitored at different locations within the system. These values could also be predicted as functions of distance travelled in the drier through a computer simulation of the heat and mass transfer phenomena. Theoretical and experimental data agreed well. The product can be used as a high protein feed component for ruminants or as fertilizer. (Merryman-East Central)

5800-B3, C1, C2, D1, D3 DEODORIZATION OF PIG FECES BY ACTINOMYCETES

Laboratory for Applied Microbiology, Department of Food Science and Technology, University of Hiroshima, Fukuyama, Hiroshima 720, Japan
Y. Ohta and M. Ikeda
Applied and Environmental Microbiology, V. 36, No. 3, p. 487-535, Sept., 1978. 2 fig., 2 tab., 8 ref.

Keywords: Swine wastes, Deodorization, Actinomycetes, pH, Temperature, Moisture content, Fatty acids, Microorganisms, Gas chromatography, Dehydration, Hydrolysis, Phosphorus, Potassium, Streptomyces species

Pig feces, a malodorous substance causing environmental pollution, were completely deodorized within 2 days by Streptomyces. The optimum conditions for deodorization were as follows: pH, 8.6 to 10; temperature, 35 to 40°C; moisture content, 42 to 63%; and minimum amount of inoculum, 2 g of seed culture per 10 g of fresh feces. Many kinds of microorganisms were isolated from the deodorized feces, of which only actinomycetes were found to have the ability to deodorize. Two strains with strong deodorizing activity were identified as *Streptomyces albus* and *Streptomyces antibioticus*. The low-molecular-weight fatty acids, which are specific malodorous agents of pig feces, scarcely could be found in feces deodorized by the isolated strains. Chemical analysis showed that the deodorized feces are useful as manure. (Ohta-University of Hiroshima)

5801-B3, C2, D3 PROBABILITY ANALYSIS FOR ESTIMATING THE VARIABILITY IN NITROGEN, PHOSPHORUS AND POTASSIUM CONTENTS OF FARMYARD MANURES

Punjab Agricultural University, Ludhiana 141 004
K.N. Sharma, B. Singh, D.S. Rana, and M.L. Kapur
Indian Journal of Agricultural Science, V. 48, No. 12, Dec., 1978, p. 718-722. 3 fig., 1 tab., 4 ref.

Keywords: Nitrogen, Phosphorus, Potassium, Animal wastes, Dehydration, Sampling

Probability analysis was applied to the contents of nitrogen, phosphorus, and potassium of 90 randomly collected farmyard manure samples in the Jullundur district of

Punjab, India. In the case of nitrogen, the population could be considered normally distributed. Graphical tests indicated that phosphorus and potassium were not normally distributed. Probability plots indicated that 50% of the farmyard manures contained up to 0.63% nitrogen, 0.086% phosphorus and 0.85% potassium. The relationships between the nitrogen content in the samples and ratios of N:N, N:P and N:K were computed. The statistical parameters for the total nitrogen, phosphorus, and potassium contents of the farmyard manure samples were given. (Little-East Central)

5802-A11, B1, B2, B3, C2, E3, F1 THE RESULTS OF MANURING ON INTENSIVE GROWTH FISH FARMING AT THE GINOSAR STATION PONDS IN 1977

Intensive Fish Culture Station, Fisheries Department, Ginosar, Israel
U. Rappaport and S. Sarig
Bamidgeh, V. 30, No. 2, p. 27-37, June, 1978. 4 fig., 5 tab., 2 ref.

Keywords: Fish farming, Liquid wastes, Poultry wastes, Fertilizers, Cattle wastes, Performance, Recycling, Ponds, Ammonia, Nitrogen, Carbon, Economics

1. This year's experiments in the use of dry chicken droppings showed results identical to those of last year using the same manure but in liquid form. This is proof that dry chicken droppings may be used with absolute confidence and there is no need for the special and complicated manipulations involved in its liquification. 2. This year as in the previous year, chicken droppings produced decidedly superior results to those of cattle manure. 3. Supplementary addition of chicken droppings under conditions of intensive growth and at a density of 20,000 fish/ha increased the yield during the entire growth period by 21% and decreased the feed conversion rate by 0.4 units. 4. Manuring had a pronounced effect during all 3 growth seasons and was decidedly advantageous during the second season which was the warmest. 5. Once again, just as last year, the rise in temperature during the second season effected an increased growth rate. 6. Chemical analyses of the pond bottom for nitrogen content, carbon and organic matter showed that there were no essential differences between the ponds manured with chicken droppings and the non-manured plots. 7. An economic analysis shows that the positive effect of manuring on yield level is accompanied by a decided increase in profitability. (Rappaport-Fisheries Department)

5803-A11, B1, C2, E3, F1 INCORPORATION OF DPW, UR- EA AND FISH MEAL WITH VARYING MOLASSES LEVELS IN CATTLE FEEDLOT RATIONS

Voermol Products Limited, P.O. Box 13, Maidstone, 4380 J. Kargaard and B.D.H. van Niekerk
South African Journal of Animal Science, V. 7, p. 117-125, 1977. 7 tab., 21 ref.

Keywords: Poultry wastes-dried, Energy, Economics, Maize, Molasses, Fish meal,

Crude protein, Feed supplements, Performance, Refeeding, Calcium, Phosphorus

With the increasing shortages and high costs of conventional feedstuffs, an investigation was conducted to find an alternative protein and energy source for use in cattle feedlot rations. The experimental design was a 2 x 3 x 4 factorial arrangement. The value of fish meal, urea and dried poultry waste as protein sources, as well as the value of molasses as a replacement for maize meal in beef fattening rations were studied. Twelve animals were slaughtered to estimate the initial carcass mass and the remaining 120 animals were used in the feeding trial itself. Fish meal yielded significantly superior rates of live plus carcass mass gain and feed conversion rates than urea or artificially dried poultry layer manure (DPW). Urea gave significantly better results than DPW. At the 7% and 14% levels, the replacement of maize meal with molasses did not have any significant effect on a dry matter basis. At the 21% level, molasses had a marked depressing effect on the rate of live and carcass mass gain. The vitamin A treatment did not effect any of the criteria. It should be recognized that the use of molasses as an energy substitute for grain, and the inclusion of DPW and urea as a protein source may be helpful in the future. (Little-East Central)

5804-B3, C2, C3, D3, E3 DISPOSAL OF AEROBIC TREAT- ED SWINE WASTE

Mit Unterstützung der Deutschen Forschungsgemeinschaft
K. Drepper, J. Kalich, P. Mielmann, U. Riemann, and W. Schuh
Zentralblatt für Bakteriologie Parasitenkunde und Hygiene, 1. Abt. Orig. B 164, p. 567-580, 1977. 2 fig., 9 tab., 18 ref.

Keywords: Waste treatment, Swine wastes, Waste disposal, Aerobic treatment

Simple aerobic treatment of swine waste did not increase the production of microorganism-protein (pure protein). Addition of available energy resulted in a small increase of pure protein: During continuous aerobic treatment 20 g pure protein were produced by 100 g starch, during discontinuous aerobic treatment 9 g pure protein by 100 g organic matter from molasses (mean values). Comparative feeding trials with 90% resp. 80% feed restricted finishing swine without and with added swine waste (continuous treated without supplements resp. discontinuous treated with addition of yeasts and molasses) had as results no improvement in body-weight-gain but a 12% resp. 17% deterioration in feed conversion with 13% less bodyfat formation. Weight gains of both groups with restricted feed (without and with added swine waste) was 22% less in comparison to full fed swine. Losses at slaughter of swine in the group with feed restriction and added swine waste were partly due to higher intestine contents higher than that of swine with feed restriction and without added swine waste. Higher weights of livers and kidneys in swine of the 'waste-group' counts for a possibly higher metabolism-stress. (Drepper-Institute Tierernährung und Futtermittelkunde sowie Landwirtschaftliche) (Article in German)

5805-A11, B1, B3, C1, C2 D3, E3 ENSILING CHARACTERISTICS

AND NUTRITIONAL VALUE OF CATTLE WASTE ENSILED WITH RYE STRAW AT VARIOUS DRY MATTER AND SODIUM HYDROXIDE TREATMENT LEVELS

Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
G.E. Aines, W.D. Lamm, K.E. Webb, Jr., and J.P. Fontenot
Livestock Research Report, Research Division 175, Virginia Polytechnic Institute and State University, p. 93-99, July, 1979. 4 tab.

Keywords: Ensilage, Cattle wastes, Dry matter, Sodium hydroxide, Design, Collforms, Digestibility, Wastelage, Sampling, Nitrogen, Performance, pH, Diets, Refeeding

Treatment of the wastelages with NaOH increased *in vivo* dry matter, organic matter and crude fiber digestibility compared to the untreated wastelage. However, NaOH treatment decreased crude protein digestibility. Addition of NaOH also increased the pH of the material prior to ensiling and many have aided in the elimination of pathogenic organisms. After ensiling, the high-concentrate NaOH-treated wastelages showed pH values of approximately 5 as compared to the untreated high-concentrate wastelage with pH values around 4. Small numbers of *Proteus* organisms were found in wastelages with pH 5 and above. The high-roughage NaOH-treated wastelage did not show the dramatic decrease in pH after ensiling and both coliform and *proteus* organisms were found at low levels. In addition, nitrogen in the high-roughage wastelage was not utilized as efficiently as nitrogen in the high-concentrate wastelages. (Aines-Virginia Polytechnic Institute and State University)

5806-A11, B1, B3, C1, C3, D1, D3, E3

PERFORMANCE OF HEIFERS FED CORN SILAGE SUPPLEMENTED WITH DEEP STACKED OR ENSILED BROILER LITTER

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G.R. Dana, J.P. Fontenot, M.D. Hovatter, K.E. Webb, Jr., and W.D. Lamm
Livestock Research Report, Research Division 175, Virginia Polytechnic Institute and State University, p. 65-68, July, 1979. 2 tab.

Keywords: Performance, Refeeding, Poultry litter, Ensiling, Anaerobic, Moisture content, Mixing, Cattle, Sampling

Dry matter and crude protein of ration ingredients are given. The corn silage was of good quality, containing 38.2% dry matter and 8.2% crude protein (dry basis). The crude protein tended to be higher for the deep stacked litter than for the ensiled litter, 35% vs. 31.4%, respectively, dry basis. The dry matter content of the litter rations (1 and 2) was similar, and was higher than for the control ration. The control ration provided 12.6% crude protein, dry basis. The litter sources were added at quantities that provided excess crude protein. The trial is still in progress. Performance data of the heifers fed the three rations after 112 days are given. Dry matter intake, expressed as pounds per day, was highest for the cattle fed corn silage and deep stacked litter (16.3), and lowest for

those fed corn silage and soybean meal (12.8). Average daily gain ranged from 1.91 lb for the cattle fed the deep stacked litter to values of 1.77 and 1.76 lb for those fed ensiled litter and soybean meal, respectively. Dry matter intake per pound of gain was similar for heifers fed both the deep stacked litter and ensiled litter rations (8.51 and 8.31 lb, respectively). The value for heifers fed the control ration was 7.27 lb dry matter per pound of gain. (Dana-Virginia Polytechnic Institute and State University)

5807-A11, B1, B3, B4, C1, C2, D1, D3

EFFECT OF COPPER IN SWINE DIETS ON FRESH WASTE COMPOSITION AND ANAEROBIC DECOMPOSITION

Purdue University, West Lafayette, Indiana 47907
M.C. Brumm and A.L. Sutton
Journal of Animal Science, V. 49, No. 1, p. 20-25, 1979. 2 fig., 5 tab., 17 ref.

Keywords: Copper, Waste composition, Anaerobic pits, Diets, Decomposition, Swine, Waste storage, Feed additives, Mixing, Kjeldahl nitrogen, Performance

An experiment was conducted to determine the effect of copper sulfate in swine diets on fresh waste composition and on decomposition of the waste stored in anaerobic pits. Vitamin and mineral fortified corn-soybean meal diets with 0, 125 and 250 ppm copper were fed to growing-finishing pigs (18 to 91 kg) in spring and summer trials with daily fresh waste collection and addition to anaerobic pits. Copper concentrations (wet basis) in the anaerobic pits from pigs fed the 0, 125 and 250 ppm copper diets for trial 1 were 3.15, 34.27 and 44.63 ppm, respectively. For trial 11, copper concentrations were 3.55 and 48.61 ppm, respectively, for diets containing 0 and 250 ppm copper. Average elemental copper excretion for the 250 ppm copper diets ranged from 433 to 490 mg per head per day. The presence of copper sulfate in swine diets did not affect fresh waste composition. Copper sulfate decreased the decomposition of the waste in anaerobic pits as shown by the greater reduction of dry matter and volatile solids in waste from pigs fed no copper sulfate. Dry matter content was reduced 65% in anaerobically stored waste from pigs fed 0 ppm copper, while the dry matter content was reduced only 55 and 51% from pigs fed the 125 ppm and 250 ppm copper diets in trial 1. In trial 11 the dry matter was reduced 41% for the 0 ppm stored waste and 31% for the 250 ppm stored waste. (Brumm-Purdue University)

5808-A11, B2, B4, C1, C2, D1, D2, D3, E3, F1

RECIRCULATION OF TREATED PIG EFFLUENT AS THE DRINKING WATER

Trawsgoed Experimental Husbandry Farm, Aberystwyth, Dyfed SY23 4HT
M.L. Yeo and D.F. Gibbs
Animal Production, V. 26, p. 367, 1978.

Keywords: Waste treatment, Recirculation,

Slurries, Settling, Anaerobic tank, Effluent, Aeration, Biochemical oxygen demand, Flocculation, Copper, Zinc, Nitrite, Economics, Recycling

Slurry from the pig unit at Trawsgoed Experimental Husbandry Farm is treated by a scaled-down version of a town sewerage plant. The process starts with slurry passing over a vibrating screen, which separates out half of the solids. After settling in an anaerobic tank the effluent passes into a tank containing activated sludge. This tank is aerated by a Simcar surface aerator. The material then passes to a final settling tank which produces the final effluent containing approximately 120 BOD₅, 250 suspended solids and 200 nitrogenous compounds (mg/l). This liquid is flocculated with ferric chloride and lime. After hydrochloric acid is added and it has been treated with sodium hypochlorite a neutral odourless clear liquid is produced containing approximately 10 BOD₅, 0 suspended solids, 200 nitrogenous compounds 0.2 copper and 0.2 zinc (mg/l). In trial 1 pigs were offered either tap water or polished effluent through drinking bowls and fed dry on the floor. No differences in liquid intake were recorded. However, increased levels of nitrogenous compounds were found in the urine of pigs consuming polished effluent. Trial 2 involved wet feeding and no significant differences were found between any carcass or growth parameters. The treated effluent was also used in a commercial wet feeding system (Taymix) and here three pigs died from nitrate poisoning. Successful feeding depends on feeding less than lethal levels (>20 mg/kg live weight) of nitrite, by diluting the effluent with tap water. Mains water costs are currently 64p per 4500 l and treating this amount of final effluent with hydrochloric acid and sodium hypochlorite, costs 30p. Water charges can therefore be reduced using this process. (Yeo-Trawsgoed Experimental Husbandry Farm) (Abstract Only)

5809-B1, B2, B3, D1, E3, F1

THEY SOLVED THREE PROBLEMS WITH ONE NEW MANURE SYSTEM

L. Elam
Hoard's Dairyman, V. 124, No. 16, p. 1061, August 25, 1979.

Keywords: Cattle wastes, Scraping, Economics, Lagoons, Recycling

A manure system was developed by the Gibson family for the Lockmead Dairy, Junction City, Oregon. The new system eliminated the problems of old dairy buildings that meant inefficient manure scraping, a system that would cut costs of getting manure out of the aisles in free stall and feeding areas, and how to combine a new manure handling system into a new building for housing the herd. The new manure system will get manure into a form that can be handled. It provided labor and cost savings. The new plan incorporated buildings with free stalls and covered feeding mangers for the milking herd. An automated system scraped free stalls and feeding alleys every one-half hour. Scraping was accomplished with a blade on a cable driven by an electric motor. The blade in each aisle pushed manure to a cross conveyor at one end of the barn. When the manure was dumped, the bar folded at the center and was returned to the starting point. Up to 11,000 gallons of manure and waste water per day goes into the system. The solid portion of the waste was sold at a reasonable profit. During

the dry season, water is removed from the lagoon and is used on alfalfa, corn and seed crop ground. This cuts fertilizer costs. The lagoon was built at a cost of \$27,000. The manure separator and pit with its pumps cost about \$8,000. Cost of the scraping system in the barn was \$20,000. A future improvement of the system is to drop solids onto a belt conveyor which can automatically place the solids over the storage area or move them directly into a waiting truck. (Little-East Central)

5810-A10, E3, F1 LITTER USEFUL AS FERTILIZER, FEED, TURKEY SEMINAR TOLD

Anonymous
Feedstuffs, V. 51, No. 34, p. 7, 48, 49, August 20, 1979.

Keywords: Turkey wastes, Economics, Waste utilization, Refeeding, Nitrogen, Phosphorus, Potassium, Performance, Fertilizer

Cattlemen in Arkansas have realized a gain of 2.5-3 lb. daily from feeding part turkey litter. Turkey litter makes a satisfactory feed supplement and fertilizer. Analyses of the litter have shown nitrogen at 2.39%, phosphorus at 5.84% and potassium at 3.31%, indicating it is a valuable source of nitrogen, phosphorus and potassium and can be used well in a sound fertilizer program. Most recommendations call for two tons per acre annual basis for cool season grasses and four tons per acre for warm season grasses. As a cattle feed supplement, turkey litter can be mixed with grain when forage and hay are not available. The following grain to litter ratios can be used: (1) for wintering cows, 30:70, (2) for calves over 450 pounds, 50:50, and (3) for finishing steers, 70:30. Litter has a low energy value and feed formulations including turkey litter should be mixed for optimum performances. (Little-East Central)

5811-A8 ANTIBIOTICS IN MANURE MAY AFFECT SOIL BACTERIA

Anonymous
Hog Farm Management, V. 16, No. 9, p. 67, 68, Sept., 1979.

Keywords: Animal wastes, Antibiotics, Heavy metals, Soils, Feed additives, Penicillin, Streptomycin, Tetracycline

Research was conducted at the University of Arkansas Agricultural Experiment Station, Fayetteville, Arkansas to study the effects of antibiotics fed to animals and then applied to the soil through the animals' feces. The antibiotics - penicillin, streptomycin and tetracyclines, and heavy metals found in sewage sludge were studied. It was found that a high heavy metal concentration resulted in bacteria resistant not only to the heavy metal, but also to certain antibiotics. This three-year research project will be conducted in three stages. Determination of the number of heavy metal-antibiotic resistant soil bacteria in various soils which have a history of heavy metal and/or antibiotic amendment is the first stage. The researchers will then isolate selected bacterial colonies and determine the specific resistance patterns. Additional research will be done on the more promising cultures to determine the mechanism of resistance. (Little-East Central)

5812-B2, C1, C2, D2, D3 FLOCCULATION OF ANIMAL SLURRIES: AN INVESTIGATION INTO THE ELECTROKINETIC PROPERTIES OF COLLOIDAL PARTICLES PRESENT IN PIG SLURRY

Department of Chemical Engineering, University College of Swansea, Swansea, SA2 8PP, United Kingdom
S.T. Thuralingham, J.A. Howell, and D.J.A. Williams
Biotechnology Letters, V. 1, Part 1, p. 27-30, 1979. 2 fig., 6 ref.

Keywords: Flocculation, Swine wastes, Slurries, Effluent, Cations, Hydrolysis, Aeration, pH, Biochemical oxygen demand

Electrophoretic mobility studies of colloidal particles in pig effluent show that hydrolyzable cations reverse the charge of these particles only in freshly aerated effluent. Effluent which had been left standing for longer than fifteen to twenty days after aeration shows no charge reversal. Optimal flocculation cannot be achieved for this effluent. (Thuralingham-University College of Swansea)

5813-AH, B3, E3, F1 REPLACEMENT OF COTTON- SEED MEAL BY BROILER POULTRY LITTER OR CAGE POULTRY MANURE FOR FEEDING STEERS IN DRY LOT

Professor da Escola Superior de Agricultura de Lavras - MG
I.M.E.V. von Tiesenhausen, H. Vilela, C.S. Pereira, J.A.F. Veloso, and S.S. Cavalcanti
Arquivos Da Escola De Veterinaria, V. 30, No. 1, p. 89-100, 1978. 7 tab., 22 ref.

Keywords: Poultry litter, Poultry wastes, Refeeding, Performance, Animal health, Economics

An experiment was conducted to determine the effects of replacing poultry litter by cottonseed meal in a fattening ration of steers. Thirty-three Zebu steers, averaging 42 months of age and 328 kg liveweight, were randomly assigned to three treatments with 11 animals each. The diets were: Treatment I - 27% cottonseed meal - corn meal, Treatment II - 48% cage poultry manure - 52% corn meal, Treatment III - 50% broiler poultry litter - corn meal. In all treatments the animals received chopped elephant grass (*Pennisetum purpureum Schum*) variety "mineiro", water and a mineral supplement ad libitum. The average dry matter daily consumption per steer was 8,416 kg (approximately 37% from the concentrate feed). Weight gains were significantly higher on Treatments I and III than II. Average daily gains in kg were: 0,842; 0,799 and 0,834 on Treatments I, III and II, respectively. Feed intake was lower on Treatment II than other diets, and carcass grades were higher for steers on I and III than on II. There were no apparent ration effects on the livers, hearts and lungs of the slaughtered experimental animals according to the veterinary inspection techniques. Using prices prevailing at the time of the experiment, diet III, with broiler litter was more economical than II and I, and I was more economical than I. (von Tiesenhausen-Escola Superior de Agricultura de Lavras) (Article in Portuguese)

5814-AH, B3, C2, D1, E3 DEHYDRATED MINK MANURE AS A PROTEIN SOURCE FOR GROWING PIGS

Department of Animal Husbandry, University of Helsinki, Finland
M. Naal, H. Saloniemi, and K. Kallala
Acta Veterinaria Scandinavica, V. 19, No. 1, p. 73-83, 1978. 1 fig., 5 tab., 12 ref.

Keywords: Mink waste-dried, Swine, Refeeding, Digestibility, Crude protein, Performance, Carcass quality, Waste composition, Amino acids, Calcium, Phosphorus, Magnesium, Sodium, Potassium, Iron, Copper, Manganese, Zinc, Dehydration

The use of dehydrated mink manure as a protein source for growing pigs was studied by substituting 7.5 and 15% (w/w) of the complete feed with manure and a corresponding amount of barley. The manure used had a poor feed value as compared to the values obtained earlier in digestibility tests in minks. The crude protein content was 21.3%. The addition of mink manure to the feed did not adversely affect the feed consumption, nor were any effects on the health of the pigs observed. The differences in daily gain and feed efficiency recorded between the experimental groups were not small, and a large variation occurred within the groups. The addition of mink manure to the diet resulted in lower weight gain, apparently due to a lower energy supply. The groups given mink manure received less feed units than the controls. No harmful effects of the manure feeding on carcass quality was observed and organoleptic tests revealed no changes in the smell or taste of the meat. No changes were found in the digestive tracts, livers, kidneys of the pigs. (Nasi-University of Helsinki)

5815-A11, B3, D1, E3 HEMATOLOGICAL AND BLOOD CHEMICAL DATA OF PIGS FED VARIOUS AMOUNTS OF MINK MANURE

Department of Animal Husbandry, University of Helsinki, Finland
M. Naal, H. Saloniemi, and K. Kallala
Acta Veterinaria Scandinavica, V. 19, No. 1, p. 84-92, 1978. 5 tab., 17 ref.

Keywords: Mink waste-dried, Swine, Sampling, Animal health, Blood analyses, Phosphorus, Calcium, Magnesium, Potassium Iron, Copper, Zinc, Refeeding, Dehydration

The effect of feeding mink manure to pigs and the utilization of its protein and mineral content was studied by blood analyses. Individual variation was large, and the differences between groups were small. Growth of the animals had a significant effect on the levels of several blood components. Judging from the blood analyses, mink manure feeding did not have any harmful effects on the health of the pigs, and the differences to normal feeding were small. (Nasi-University of Helsinki)

5816-AH OXYTETRACYCLINE ABSORP- TION AND EXCRETION IN WE- THERS

Bureau of Veterinary Medicine, Food and Drug Administration, Beltsville, Maryland 20705
B.D. Bradley, N.E. Alderson, W.M. Knight, J.J. Colaienne and H.H. Bryant
Journal of Animal Science, V. 48, No. 6, p. 1464-1469, 1979. 4 tab., 22 ref.

Keywords: Oxytetracycline, Sheep, Excretion, Absorption, Diets, Sampling, Animal health

Three trials were conducted to evaluate the absorption and excretion of oxytetracycline (OTC) in wethers. In trial 1, six wethers were given 1 g of OTC per day for 14 days orally or abomasally (via abomasal fistula) and were fed either a high or low fiber diet. OTC was detected in serum 1 and 4 hr post-dosing in abomasally and orally dosed wether, respectively. Abomasally dosed wethers had higher ($P < .01$) OTC levels in serum collected serially on the first day of dosing. Wethers dosed abomasally and [or] fed a low fiber diet had higher ($P < .01$) OTC levels in serum collected on day 14. In the second trial, four wethers were dosed orally (via rumen fistula) and abomasally for 14 days with 1.0 g of OTC per day. The same design was used in the third trial, but 100 mg of OTC were administered per day. Route of administration in trial 2 had an effect ($P < .01$) on OTC levels in serum collected serially on the first day of dosing, as seen in trial 1. In trial 2, wethers dosed abomasally had higher mean fecal OTC recovery ($P < .05$) and 14-day serum levels ($P < .01$). Serum OTC levels in trial 3 were below the detectable level. While route of administration in trial 3 produced no detectable effect ($P > .05$) on recovery of OTC in the feces, abomasally dosed animals had higher values as was observed in trial 2. (Bradley-Food and Drug Administration)

5817-A8, B4, F1 MANURE CREDIT MAY OFFSET SILAGE COST

Anonymous
Beef, V. 18, No. 1, p. 34, Sept., 1978.

Keywords: Economics, Silage, Waste handling, Manure credit, Waste storage, Soils

According to Michigan State University scientist Roy Black, cattle feeders must consider more than just cost of feed and rate of gain when selecting a feeding program that is best for their particular operation. They must also consider the amount of grain in the ration which has a direct influence on the costs in a feeding program through feed and manure handling. The more silage in the ration causes feed handling and manure hauling costs to increase. Using data from a two-year feeding trial, experts have estimated the total costs of a high-silage ration (containing 30 percent grain) to be 18.09 cents per animal per day. The same net cost of a high-grain concentrate ration was 13.38 cents per animal per day. Selection of the most profitable feeding program must take into consideration: feed handling (three times greater for an all-corn silage ration); manure handling and storage capabilities; and the value of the manure, which varies in volume and ability to contribute to soil nutrient levels. (Stiles-East Central)

5818-B1, B2, D3, E2 UPDATED DAIRIES EASE MILK FLOW

H. Ernst
Missouri Ruralist, V. 120, No. 14, p. 40, August 25, 1979.

Keywords: Waste handling, Waste management, Gutter flushing, Soda ash, Lagoons

The Carl Flennikens of Carthage, Missouri have found workable solutions to their labor needs. The Flennikens had a three-on-side bypass milking parlor to milk their 85 cows with a current rolling herd average of 13,500 pounds. Manure was scraped and loaded daily from the holding pen taking an excessive amount of time. With the help of Jerry Carpenter, Extension agricultural engineer, Flenniken has upgraded his parlor to a seven-cow herringbone and added the gutter flush concept to the holding pen. Only a few more yards of concrete were needed to build a ramp to the planned lagoon. A specialized pump positioned two feet above the floor moves water to the 2,300-gallon flush tank which is filled within one-half hour. Water is allowed to escape to "pre soak" the holding pen floor prior to twice-a-day flushing. Flushing in the winter has not been too successful. Now stabilized, Flenniken is considering irrigation of an adjacent 25-acre field. Current goal is to raise the rolling herd average to 17,000 pounds. (Stiles-East Central)

5819-A8, A10, B2, C2, C3, D3, E3, F1 ANAEROBIC DIGESTION OF LIVESTOCK MANURE TO GEN- ERATE METHANE

College of Agriculture, Washington State University, Pullman, Washington 99163
R.E. Hermanson
EM Cooperative Extension Service Bulletin No. 3937, June, 1975, 3 p. 2 tab.

Keywords: Anaerobic digestion, Methane, Digesters, Bacteria, pH, Temperature, Gases, Slurries, Nitrogen, Phosphorus, Potassium, Economics, Volatile solids, Soil conditioning, Flies, Recycling

Certain anaerobic bacteria or microorganisms produce methane while decomposing organic matter such as manure under proper operating conditions. The methane gas generated by the anaerobic process is primarily methane and carbon dioxide. A substantial portion of the gross energy produced is required to heat and mix the digester, pump the manure slurry into the digester, pump the digested slurry out, and possibly compress the gas for storage. Advantages of anaerobic digestion include: (1) The waste is well stabilized. (2) Freeflowing sludge is easily dewatered. (3) Sludge is odor free. (4) Fertilizer nutrients are conserved. (5) Sludge is a good soil conditioner. (6) Rodents and flies are not attracted to sludge. (7) Process produces combustible methane. Disadvantages of anaerobic digestion are: (1) Initial investment is high. (2) Daily close technical supervision and feeding is required. (3) Methane is explosive—air must not enter digester. (4) It is not a disposal system—must dispose of sludge. (5) A safe way to store gas is needed. Methane required 658 PSI and -116°F. to liquefy. (6) Engines need special carburetion equipment. Environmental conditions needed for an anaerobic digester include: (1) Temperature - External heat required to maintain optimum 95°F. (2) Solids content - Mix manure with water to make slurry of 7%-9% solids. (3) Loading rate - 0.2 pounds volatile solids per cubic foot of digester. (4) Mixing - Continuous mixing to keep organic solids in contact with bacteria.

(5) Detention time of 10-40 days. (6) Initial seeding with contents of municipal digester contents will speed start-up. (7) pH should be 6.5-7.5. The anaerobic digestion process includes: (1) Anaerobic bacteria grow only in absence of free oxygen—digester must be airtight. (2) Organic matter is first liquefied by acid-forming bacteria. (3) The liquid is then gasified by methane-forming bacteria. (4) The process depends on a delicate balance between these bacteria. (Stiles-East Central)

5820-A8, B2, C1, D1 DETERMINATION OF PHOSPHATASE ACTIVITIES OF SOILS AND ANIMAL WASTES

Institute for Soil Fertility, Haren (Gr.), The Netherlands
R.G. Gerritse and H. van Duk
Soil Biology Biochemistry, V. 10, p. 545-551, 1978. 4 fig., 7 tab., 18 ref.

Keywords: Phosphatase, Soils, Animal wastes, Liquid chromatography, Phosphorus, Decomposition, Slurries, Dehydration, Adsorption, Sampling, Temperature, Waste storage

A method is described to determine acid and alkaline phosphatase activities from the rate of decomposition of *p*-nitrophenylphosphate in the presence of large amounts of organic matter, such as occur in the surface layers of soils or in animal wastes. The *p*-nitrophenol formed is separated by high pressure liquid chromatography on a cellulose column from *p*-nitrophenylphosphate and other organic compounds present in the soil or waste extract. After separation, *p*-nitrophenol is measured on-line in a spectrophotometric flow cell at a wavelength of 405 nm. In this way *p*-nitrophenol concentrations down to 0.1 μ M can be measured, making it possible to work with substrate concentrations of 1 μ M. The necessity of correcting the phosphatase activity measured in this way for adsorption of enzyme, substrate (*p*-nitrophenylphosphate) and product (*p*-nitrophenol) is discussed. Acid and alkaline phosphatases are inhibited strongly at phosphate concentrations greater than 0.1 mM, consequently substrate concentrations in the range of 0.01 to 0.1 mM were used. The method was applied to a number of sandy soils and to pig slurry. Air drying or freeze drying of soils was found to decrease the phosphatase activity. Freeze drying did not affect the phosphatase activity of pig slurry. Michaelis-Menten kinetics were found to apply reasonably well. The resulting kinetic parameters are compared with values from the literature. Phosphatase activities are correlated with organic P and organic matter contents of soils and pig slurry. (Gerritse-Institute for Soil Fertility)

5821-A11, B3, E3 STUDIES ON THE ENERGY VALUE OF PELLETS PREPARED FROM FAECAL SOLIDS

Forschungszentrum für Tierproduktion Dummerstorf-Rostock, Bereich Tierernährung, DDR-25 Rostock, Justus-von-Liebig-Strasse 1
W. Jentsch, R. Schlemann, and H. Wittenburg
Archiv. Für Tierernährung, Bd 27, 1977, H.2, p. 117-133. 19 ref.

Keywords: Swine wastes, Refeeding, Cattle, Sheep, Butyric acid, Performance

improve manure drying under cages in the types of relatively open cage houses used in San Diego County, California. (1) For drying manure in the winter, open house during warmest part of the day. (2) Increase exposure of wet droppings by having them drop on cones or inverted "V" pads. (3) Pick up dry manure in aisle and throw into center below back-to-back cages. (4) Rough up, cone or form an inverted "V" if possible after cleanout of wet material so additional material will dry as it accumulates. (5) Save at least an 8- to 12-inch pad of dry manure after summer cleanouts. (6) Stirring of the manure for 6 or 8 weeks after cleanout may help start a dry pad. (7) Manure that has been turned several times outside the house and composted to kill fly pupae may be useful in starting a new base. (8) The most important factor in operating a biological control program is to keep the accumulating manure moisture level as low as possible. (9) Composting by aerobic bacteria is possible only in the drier manure. (1) Maximize good movement of warm, dry air. Plenty of dry manure base serves as a reservoir of litter to absorb moisture and increase the exposure area of fresh droppings and also improves air movement over moist manure additions. (Stiles-East Central)

5827-C3, D3, E3 FEED ADDITIVES EFFECT ON SWINE WASTE

Agri-Nutrition Services, Inc., 1221 E. Fourth Ave., Shakopee, Minnesota 55379

J.H. Golli
Feedstuffs, V. 51, No. 37, p. 67, Sept. 10, 1979.

Keywords: Swine wastes, Arsenic acids, Copper, Dry matter, Anaerobic pits, Refeeding, pH, Volatile solids, Nitrogen, Decomposition, Feed additives

Two swine feeding experiments were conducted at Purdue University to study the effects of two dietary feed additives, arsenic acids or copper, on fresh swine waste composition and anaerobic decomposition. The following conclusions from the study were: (1) Roxarsone in the diet decreased pH slightly and arsenilic acid increased pH when compared to control. (2) Both of the arsenic acid treatments had lower dry matter contents than control. (3) In all AA pits, Kjeldahl nitrogen and ammonium nitrogen increased with storage time. (4) The levels of arsenic were decreased approximately 40% from that level in the fresh waste after anaerobic decomposition. The loss was possible because of volatile arsenic hydrides. The copper levels decreased by a similar amount. (5) The increased dry matter decomposition in the anaerobic pits, with the inclusion of arsenilic acid in the diet, agreed with earlier work. (6) Compared with the waste from pigs fed no supplemental copper, the presence of copper in the diets caused increased dry matter and volatile solids concentration in anaerobic pits. (7) Both studies indicated that copper in swine diets inhibits the anaerobic decomposition of the stored waste. (8) Fresh waste composition was not significantly affected by the presence of copper sulfate in the diet. (9) Copper may indirectly influence the microbial population in the anaerobic pit or may alter microorganism population of the pig. (Little-East Central)

5828-B4, B5, D1, E2, F1 INTEREST IN MANURE STORAGE CONTINUES TO GROW

Anonymous
Hoard's Dairyman, V. 124, No. 17, p. 1129, 1181, September 10, 1979.

Keywords: Cattle wastes, Land application, Agitation, Fertilizer, Waste storage, Economics, Nitrogen

According to a recent survey by HOARD'S DAIRYMAN, there is a strong trend toward storing manure rather than daily hauling. Advantages of storing manure rather than hauling daily are: (1) lower fertilizer bills, (2) less chore routine, and (3) more time with crops and cows. In 1978, Emerald Osman and his sons began working with Brown County, Wisconsin dairy agent to find a workable plan for storage of their manure. They built a massive earthen basin (2.1 million gallons) with a two-pump system that enabled them to handle a year's manure production with room to spare. The circular storage has a 130-foot diameter at the bottom and 150 at the top. It's nine to ten feet in depth and is located on the fringe of the barnyard where it doesn't interfere with cow traffic or silo filling. The manure moves to the basin through two 12-inch PVC pipes, both about 210 feet long. When it is available, the Osmans prefer to bed with shavings at a cost of \$30 per chopper boxful. Sawdust is adequate but it tends to settle out in the basin. Long hay and straw will not go through the pumps (if they do they tend to wrap around the agitator causing problems in the basin). One drawback the Osmans see with storing manure is that it concentrates hauling into one or two seasons, usually in the spring when it conflicts with other fieldwork. They use two spreader tanks which enables them to haul a load every 15 to 30 minutes. To make sure nitrogen in the manure is not lost, it is disced during the spring application and plowed down on corn ground in the fall. They apply about 9,000 gallons of manure per acre. Corn ground that has received a spreading of manure gets only 230 pounds per acre of a starter fertilizer (6-24-24). The only other fertilizer used is 30 gallons per acre of liquid nitrogen (28% nitrogen) mixed with the herbicide. Total cost for the Osmans' system was \$35,000 after concrete and rubber mats were added to their free stalls. (Stiles-East Central)

5829-A11, B2, B3, C2 HOW MUCH MANURE FROM HOGS

Texas Agricultural Extension Service, College Station, Texas 77843

Anonymous
Agricultural Engineering, V. 5, No. 3, July-August, 1979, p. 1-2.

Keywords: Swine wastes, Nitrogen, Phosphorus, Potassium, Swine, Total solids, Volatile solids, Confinement

Swine producers frequently construct new confinement swine facilities without realizing how much manure and wastewater will be produced or what treatment/disposal system will be needed. For each sow on the premise, the amount of wet manure will be about 26,100 lbs per year (13 tons per year) or 1.3 tons of dry solids. Each sow and her offspring will generate annually 195 lbs of nitrogen, 65 lbs of phosphorus (155 lbs P_2O_5), and 130 lbs of potassium (187 lbs K_2O). A table was given to determine the amount of manure a 200-sow farrow-to-finish hog operation will produce. To get the total manure load, values in the table should be multiplied by the number of sows in the herd. The table can also be used for other useful planning information such as:

(1) Liquid manure volume, (2) Flush water requirements, (3) Lagoon size, and (4) Land area for manure disposal. (Little-East Central)

5830-B1 FLUSH SYSTEMS FOR DAIRIES: DESIGN CRITERIA

Texas Agricultural Extension Service, College Station, Texas 77843

Anonymous
Agricultural Engineering, V. 5, No. 3, July-August, 1979, p. 2-3.

Keywords: Dairy farms, Design, Free-stalls, Feeding alleys

Water use and channel characteristics for flushing free stall alleys and feeding floors on commercial dairy farms were studied. Design recommendations for flush systems for free stall and/or feeding alleys were: (1) Water requirement - 40 gallons per cow per day, or two gallons per sq. ft. per day, (2) Floor finish - parallel or diamond grooves two-three inches apart, (3) Cross-slope-crowned in center (one half-inch deeper along curbs), (4) Longitudinal slope-three percent, (5) Maximum length - 200 feet, (6) Alley width - 10-14 feet, and (7) Curb height - ten inches. Recommendations were also given for cases where flush water from the milking parlor is discharged across the floor of the adjacent holding shed: (1) Water requirements - 10-25 gallons per cow per day; 1.0 gallon per sq. ft. per day, 100-150 gallons per ft. width per day, (2) Slope - 1-1.5 percent milking parlors; three-four percent holding shed, (3) Lengths - 30-50 ft. milking parlor; 100-170 ft. holding shed (200 ft. maximum), (4) Width - 20-30 ft., (5) Curb height - six-nine inches, (6) Surface finish - rough broom (parlor); grooved (holding shed), (7) Flushing frequency - two per day, (8) Tank dumping time - 7-15 seconds, (9) Number flush tanks - three (two in parlor; one in holding shed) and (10) Drain pipe size - 12 inch diameter at two-three percent slope. (Little-East Central)

5831-B2, E2, F1 CHEAPEST SIZE OF TANK WAGON FOR LIQUID MANURE SPREADING

Texas Agricultural Extension Service, College Station, Texas 77843

Anonymous
Agricultural Engineering, V. 5, No. 3, July-August, 1979, p. 3-4

Keywords: Tank wagons, Economics, Dairy wastes, Liquid waste, Land application

The most economical size of tank wagon to select depends upon the manure volume, round trip travel time to fields, and initial cost. The University of Illinois determined the cheapest vacuum-loaded tank wagon (dollars per year) for a given amount of manure. From least cost computer programming, the annual cost for the optimum-sized tank wagon was estimated. It was shown in the least-cost program that it costs only slightly more to buy the next larger size tank wagon to handle a given volume of manure. Small dairies (50 head or less) would pay three times as much for manure handling as middle-size dairies (250-300 head) on a unit volume basis. Pump-filled tank wagons require slightly more downtime but they cost less. (Little-East Central)

Model experiments were performed with full-grown sheep (16 total metabolism trials) and with young fattening bulls (in the liveweight range from 200 to 420 kg) to test the energy turnover and energy utilization in these animals of two types of rations containing 20% and 42% of solid matter extracted from semi-solid pig faeces. The following results were obtained: Faecal solids do not exert a negative influence on the energy utilization as calculated on the basis of the content of digestible nutrients. So, the energy value of rations containing faecal solids should be calculated in the same manner as for the conventional rations or feeding stuffs, i.e. on the basis of the content of digestible nutrients in them. The value of such material as feed-stuff depends, to a large extent on its energy concentration. The practical use of faecal solids in fattening rations for young bulls should be guided by the general rule that such kind of food material should at least contain 350-400 EFr units per kg of dry matter if we are to achieve satisfactory results in fattening. Sheep fed rations containing 42% of faecal solids did show signs of intolerance to this feedstuff. The feeding of faecal solids produced an increase in the content of butyric acid in the ruminal fluid in both kinds of ruminants, accompanied, in some cases, by an increase in the number of keto compounds in the blood of the young fattening bulls. (Jentsch-Forschungszentrum für Tierproduktion Dummerstorf-Rostock) (Article in German)

5822-E3, F1 CATTLE EXCRETA STOVER MAKES COMPETITIVE FEED STUFF

Iowa State University, Ames, Iowa
M.D. Boehlje and R.L. Vetter
Feedstuffs, V. 51, No. 35, p. 53, August 27,
1979. 5 tab., 7 ref.

Keywords: Cattle waste, Poultry waste-dried, Refeeding, Economics, Rations, Turkey litter, Dry matter

An analysis was performed to evaluate the economic potential of cattle and poultry excreta as ingredients in growing and finishing rations for cattle and conventional feedstuffs. The objective of the analysis was to obtain a least-cost ration considering feed and non-feed costs (25 cents per day). To accurately evaluate feed requirements and costs, the growing-finishing period was divided into three phases: Phase 1 included the weight range of 450-550 lb.; Phase 11 included 550-800 lb.; Phase 111 included 800-1,100 lb. The linear programming analysis procedure determined the optimal ration and rate of gain for each of these three phases, given prices of the various feedstuffs, their nutrient characteristics, utilization constraints and daily nonfeed costs. The data indicated cattle excreta stover can be an economically competitive feedstuff in many cattle feeding rations even at current prices, particularly during the growing phase of the feeding program. In contrast to cattle excreta which was fed in greater volume at lighter weights, broiler litter was fed in greater volume at heavier weights. The broiler litter at \$10 per ton was included in the least-cost ration at the maximum level (25% as fed), but dropped to supplemental level at \$30 per ton. Further analyses were completed by assuming processed cattle excreta with various characteristics as separate feed ingredients and can be combined in the various proportions depending upon the prices of excreta compar-

ed with other ingredients. Various types of cattle excreta material representative of different species and regions of the U.S. were analyzed. The costs of excreta were specified on a raw rather than dry matter basis because the costs of excreta removal and disposal depend primarily on volume rather than dry matter content. The dry matter content of the various excreta materials provided one of the major explanations for differences in their cost competitiveness and ability to substitute for conventional feedstuffs in least-cost rations at varying prices. (Stiles-East Central)

5823-A8, B2, C3, E2 DESIGN OF A TOOL FOR INJECT- ING WASTE SLURRIES IN SOIL

Department of Agricultural Engineering,
Macdonald College of McGill University,
Quebec, Canada H3A 1C0
E. McKyes, S. Negi, R.J. Godwin, and J.R.
Ogilvie
Journal of Terramechanics, V. 14, No. 3, p.
127-136, 1977. 10 fig., 5 ref.

Keywords: Slurries, Soils, Equipment-injectors, Aerobic, Model, Design

The objective of this project was to design a tool for the purpose of cutting, loosening and redepositing a sufficient soil volume to be mixed with a specified quantity of organic waste slurry in order to completely cover the slurry. To determine the best tool shape for this function and to minimize the draft force required in operation, laboratory tests were conducted. In this study the following conclusions were given: (1) For obtaining a given volume of loosened soil with minimum draft force and for placing waste near plant roots and in a highly aerobic environment, a wide injector operating at a shallow depth was desirable. (2) A narrow rigid shank attached to a wide flat topped injection blade with a constant approach angle was necessary for accurate depth control as well as consistent soil loosening and covering performance. (3) For operating between rows of small plants spaced at 75 cm, an injector blade of 30 cm in width was suitable. The draft force expected from this device at an operating depth of 15 cm and a suitable blade approach angle was in the range of 2 to 6 kN for soils varying from loose sand to medium clay loam. (4) The injector developed in this study demonstrated satisfactory performance because of its design and ability to cut, loosen and redeposit a sufficient volume of soil per unit travel distance to contain the injected slurry in new void spaces of the stable soil structure created. (Little-East Central)

5824-C3, D3, E3, F1 NATURAL ENERGY USE IN SWINE PRODUCTION

Agricultural Engineering Department, Uni-
versity of Illinois at Urbana-Champaign,
Illinois 61801
A.J. Muehling
Proceedings of the International Conference,
Energy Use Management, V. 1, p. 809-814,
1977. 4 fig., 9 ref.

Keywords: Swine waste, Anaerobic diges-
tion, Methane, Economics, Digesters

Increased specialization in the swine industry

during the past decade has resulted in the construction of many confinement pork production factories with complete environmental control. The recent energy shortage with drastically increased fuel costs has caused pork producers to look for ways to conserve energy and search for cheaper sources of fuel. Solar-heated hog houses are not new but have attracted new interest. Several methods are discussed for using the sun for warming the ventilation air during the winter to reduce the heating fuel bill. Automatic controls have been developed for natural ventilation, making it more attractive. This eliminates many fans, saving considerable power, and utilizes the wind for ventilation. Utilizing wind power as a source of energy for operating fans and providing supplemental heat has little application today but may develop in the future. Using an anaerobic digester for methane production from swine manure does not appear feasible for the average producer. Reducing drafts, reducing winter ventilation, and increasing insulation are management considerations that will conserve energy and utilize maximum animal heat. Designing for energy conservation and maximum utilization of natural energy will play an important part in the design of pork production units in the future. (Muehling-University of Illinois)

5825-C2, E2, F1 MANURE FOR HAY

Anonymous
Wallaces Farmer, V. 104, No. 16, p. 76,
August 25, 1979.

Keywords: Phosphorus, Potassium, Nitrogen,
Waste handling, Economics

A group of panelists for WALLACES FARMER were confronted with the following problem: Should the owner have a verbal agreement with the tenant that all hay will be fed on the farm or that all manure will be returned to the soil? Using a 1500-lb. bale as measure, how much manure should be returned? Their conclusions were: At least 6 tons per acre or about 500 lb. of manure on a dry matter basis should be returned to replace the elements. The amount of manure actually available will depend on how it is handled, type of livestock, and feeding program. Future problems can be avoided by having a clear understanding with the renter, preferably in writing. (Stiles-East Central)

5826-B1, C1, C3, D1, D3 DRYING MANURE UNDER CAGES

University of California, San Diego, California
R.H. Adolph
Poultry Digest, V. 30, p. 389, 1971.

Keywords: Poultry waste-dried, Aerobic digestion, Moisture content, Temperature, Mixing, Composting, Dehydration

The sources of manure drying under cages on poultry farms is determined by these factors: (1) Rate of air movement over an area, (2) Amount of moisture in the air, (3) Amount of moisture to be removed, (4) Temperature of the air moving over area. It is important to maximize conditions since the area under the caged birds is not an ideal location. The following suggestions have been shown to

**5832-A8, B3, C2, E2, F1
MANURE DISPOSAL ON LIMITED
ACRES CALLED FEASIBLE**

Anonymous
Feedstuffs, V. 51, No. 36, p. 17, Sept. 3, 1979.

Keywords: Economics, Land application, Soils, Nitrates, Phosphates, Salinity, Feedlot wastes, Waste disposal, Crop response, Application rates, Soil profiles

Land application to limited acreage close to the feedlot is an economical alternative for feedlot manure disposal. Charles G. Carlson of South Dakota State University Water Resource Institute stated that 0-160 tons per acre of manure (dry matter basis) were applied to plots over two years in the University's study. Inorganic chemical composition and the yields of the soil were monitored for five years. Samples of the soil were performed to a depth of five feet. The study indicated under subhumid conditions corn yields are substantially lower when manure application rates rise above 80 tons per acre when applied over a period of two years. Land application is also a good way to control pollution from feedlot runoff. Field runoff collected from the plots contained concentrations of phosphates and nitrates considerably below the Environmental Protection Agency's acceptable limits. Salinity concentrations of the soil profiles significantly dropped with time after the completion of the manure applications. (Stiles-East Central)

**5833-A7, A11, B1, B3, C2, D3
SURVEY OF NOXIOUS GASES IN
CATTLE HOUSES**

Specialist Advisory Service, Farm Buildings, Department of Agriculture and Fisheries, Dublin 2, Ireland
J.W. Loughhead
Department of Agriculture Journal, V. 122, May, 1975, 8 p. 3 tab., 8 ref.

Keywords: Gases, Cattle houses, Ammonia, Carbon dioxide, Hydrogen sulfide, Methane, Animal health, Performance, Slurries, Ventilation

A pilot survey of 13 cattle houses covering strawed and slatted floor houses showed that the concentration of the noxious gases ammonia (NH₃), carbon dioxide (CO₂), hydrogen sulfide (H₂S) and methane (CH₄) in all the houses were well below the levels likely to affect animal production and health. (Loughhead-Department of Agriculture and Fisheries) (Permission by Department of Agriculture Journal)

**5834-A10, B3
PUPARIA OF CYCLORRHAPHOUS
DIPTERA FROM BOVINE
DUNG IN OPEN PASTURE AND
RANGELAND IN THE TRANSITION
ZONE OF WESTERN NORTH
AMERICA**

Department of Entomology, University of California, Davis, California 95616
R.A. Wharton and R.D. Moon

Annals of the Entomological Society of America, V. 72, No. 1, p. 80-89, Jan., 1979. 2 fig., 45 ref.

Keywords: Cattle wastes, Bison wastes, Puparia, CycloRRhaphous diptera

A key and descriptions are presented for puparia of 26 species of cycloRRhaphous Diptera reared from undisturbed bovine dung in open pasture and rangeland. The fauna from dung of confined animals is considered ecologically distinct from the pasture fauna treated here. Species in the following genera and families are included: *Calythea*, *Hylemyia* and *Scatophaga* of the Anthomyiidae; *Gymnodia*, *Haematobia*, *Hydrotaea*, *Hypodermodes*, *Morelia*, *Musca*, *Myopila*, *Orthellia*, *Pseudophonia*, and *Spilogona* of the Muscidae; *Oxyerodexia* and *Ravinia* of the Sarcophagidae. Puparia of Sepsidae and Sphaeroceridae are treated at the family level only. (Wharton-University of California)

**5835-B3, C1, C2, C3, D3, E3, F1
BIOGAS FROM MANURE**

The Pennsylvania State University, College of Agriculture Extension Service, University Park, Pennsylvania
E.Homan, M.D. Shaw, H. Bartlett, and S. Pearson
Special Circular 260, Pennsylvania Cooperative Extension Service, 7 p. 4 tab., 4 ref.

Keywords: Biogas, Anaerobic digestion, Economics, Poultry wastes, pH, Carbon dioxide, Nitrogen, Dairy wastes, Volatile solids, Retention time, Sludge, Temperature, Methane, Digesters

A study was conducted at Penn State in response to public interest in biogas production as an energy alternative. The purpose of the study was to determine the technical requirements and economic feasibility of biogas production on the farm. The Agricultural Engineering Department in cooperation with the Dairy Science and Sanitary Engineering Departments built and tested a 3,500 cubic-foot anaerobic digester at one of the university farms. Penn State chose to study biogas production on dairy farms because: (1) manure is easily collected on dairy farms where cows are routinely confined, (2) biogas is most efficient when used directly for heating, and (3) dairy farms have a year-round demand for hot water. Under certain conditions, biogas production is economical now. It will become even more attractive to livestock farmers as the price of conventional fuel rises, and when mass production lowers the cost of digester systems. Dairy cows produce an estimated 5.5 million tons of reclaimable manure each year in Pennsylvania. Given the gas production rate of the Penn State digester, a net daily biogas output of 40 cubic feet (1.2 m) per cow, Pennsylvania dairy farmers could produce 5 billion cubic feet of biogas per year. That is enough "manure power" to provide about 20 percent of all energy used on Pennsylvania dairy farms. (Stiles-East Central)

**5836-B3, D3, E3, F1
CORN STOVER, EXCRETA MAY
BE ECONOMICAL FOR BEEF
COWS**

Iowa State University, Ames, Iowa
M.D. Boshje and R.L. Vetter
Feedstuffs, V. 51, No. 36, p. 32-33, Sept. 3, 1979. 3 tab., 8 ref.

Keywords: Economics, Sodium hydroxide, Anhydrous ammonia, Silages, Cattle wastes, Broiler litter, Refeeding, Ensilaging, Palatability

To determine the potential utilization of corn, small grain stovers, and cattle excreta and their substitution for conventional feedstuffs, least-cost consumption beef cow rations were developed. The potential feedstuffs that could be included in various beef cow maintenance rations depend in part upon the production of various feedstuffs and residues in each geographic region of the U.S. The results suggest even though corn silage and shelled corn prices were low, corn stover was a key ingredient of a least-cost beef cow maintenance ration in the Midwest. Wheat stover also was a fairly stable component of the least-cost ration in the Great Plains and Intermountain states as relative prices changed. Analyses were completed of the potential utilization of cattle excreta stover by beef cows. A total of 57.5 pounds of excreta stover was included in the daily least-cost ration. Excreta stover, priced above \$17 per ton, was not a competitive feedstuff in the least-cost ration, and the nutrient requirements of the beef cow were satisfied by hay. The economic potential of stover materials depends to a large degree on the use of high-quality material that has been properly harvested and stored to provide a palatable feedstuff. The analyses presented here indicate such high-quality stover, properly supplemented, can be a major portion of the diet. (Stiles-East Central)

**5837-B2, C1, C2, D1, D3, E3, F1
METHANE GAS GENERATION
FROM MANURE**

Extension Agricultural Engineer, Pennsylvania State University, University Park, Pennsylvania 16802
A.R. Groat
Pennsylvania Cooperative Extension Service, Agricultural Engineering Fact Sheet EPP-30, 1973, 4 p. 1 fig.

Keywords: Methane, Animal wastes, Digesters, Recycling, pH, Temperature, Mixing, Liquid wastes, Carbon, Nitrogen, Hydrogen, Economics

Methane gas production from manure has been suggested as a source of energy in the form of fuel gas for heating, cooking, and stationary power use. Research was conducted on the requirements for methane production under farm conditions. Favorable conditions for methane production are: (1) Constant temperature at 95°F, (2) Air tight digester tank, (3) Adequate mixing of liquid manure contents each day, (4) Dilution of manure with extra water, (5) Manure acidity about neutral - pH 6.0-9.0, and (6) Carbon nitrogen ratio about 30 to 1. Problems in methane production are: (1) It may be explosive; safety features must be used, (2) Wood chips in the manure make handling difficult, (3) Leakage of gas is common, (4) Hydrogen sulfide (a by-product) may cause corrosion problems on metal, (5) Methane is difficult to store, (6) To keep digester at 95°F, up to 80% of gas production is needed, (7) The system does not reduce the amount of manure, and (8) Extra labor is needed for management and maintenance of the digester. The Pennsylvania State University built a full sized digester to evaluate the production of gas from a herd of

50 dairy cows. New findings showed that heavier loading of the digester could produce more gas and handle the manure from more cows. The economic feasibility of methane generators for farm use depends on future prices of fuel for farm operations. Methane is not suggested as a fuel for field power. The practicality of methane for winter use is still in doubt. (Little-East Central)

5838-A6, B2, C3, D3 ANIMAL WASTE LAGOONS IN TENNESSEE

L.M. Safley and H.O. Vaigneur
Tennessee Farm & Home Science, No. 108,
Oct.-Dec., 1978, p. 18-19, 1 fig.

Keywords: Animal wastes, Lagoons, Anaerobic, Holding ponds, Odor, Loading rates

This study provided no precise measurements; however, several points were clearly shown: (1) Lagoons are still frequent components for both dairy and swine operations. (2) Many dairy lagoons have appreciable solids accumulations. The problems which might be caused by this are not clear. (3) Some lagoons are being loaded too heavily. This is primarily due to increasing herd size without additional lagoon volume. As a result, increased odor and floating solids are being noticed. (4) Research information is needed to determine management practices required to keep lagoons functional. This should include solids control. (5) Work is needed to accurately determine if present design loading rates are adequate. (Safley)

5839-B2, C2, C3, D3, E3, E4, F1 NEW PROCESS FOR RECYCLING AGRICULTURAL WASTE AS A SLOW RELEASE FERTILISER

Agricultural Institute, Dunsinea Research
Centre, Ireland
J. O'Shea, T.A. Spillane, and J.F. Connolly
Conservation and Recycling, V. 2, p. 269-275,
1978, 4 fig., 4 tab., 16 ref.

Keywords: Animal wastes, Recycling, Waste disposal, Methane, Carbon dioxide, Fertilizer, Pollution control, Slurries, Economics, Land application, Nitrogen, Phosphorus, Potassium, Waste storage, Digesters

A research project currently in progress in Ireland involves the recycling of animal waste in a unique manner and as a consequence, eliminates the potential pollution associated with the disposal of waste from agricultural sources. The process involves the recycling of slurry nutrients in the form of a high premium slow release fertilizer. The waste is treated biologically to produce methane gas (70%) and carbon dioxide. Then it is mixed with formaldehyde, urea and acid catalysed. Upon reaction, a solid precipitate settles out and, following neutralisation, the supernatant liquid is removed. Recent development has shown that gas production does not inhibit the chemical process in any way. To the farmer, the process offers a simple solution to a growing problem: he will be able to dispose of slurry under contract all year round; his storage and machinery requirements will be greatly reduced; his capital expenditure on new buildings will be less due to modified

designs and he will not require access to land for spreading. The process offers the non-farmer improvement to the environment which can have far reaching effects - aesthetically and financially - in a tourist region. It also offers the possibility of increased employment. (Little-East Central)

5840-B1, B3, C2, D1, E3 MINERALS AND NITROGEN IN POULTRY MANURE

Department of Animal Science, University of
Natal, Pietermaritzburg, 3200
J.B.J. van Ryssen, P. Channon, and W.J.
Stelau
South African Journal of Animal Science, V. 7,
p. 195-199, 1977, 2 fig., 3 tab., 28 ref.

Keywords: Poultry wastes, Copper, Zinc, Crude protein, Ash, Zinc bacitracin, Refeeding, Sheep, Nitrogen, Phosphorus, Calcium, Magnesium, Potassium, Sulfur, Dehydration

A study was conducted on broilers to determine to what extent copper and zinc would accumulate in the pure excreta of broilers. Half the birds received 40 g zinc bacitracin premix per 1,000 kg food and the remaining birds served as controls. The rations were supplemented with 0, 100, or 200 mg/kg Zn as Zn CO₃ and 0, 70, 140 or 210 mg/kg Cu as CuSO₄. Results showed that nutrient content varied tremendously among samples, with mineral differences being greatest when battery manure and broiler deep litter were compared. Even though samples were collected from more or less similar broiler enterprises, the crude protein content of broiler litter varied considerably. The crude protein and ash content of different types of wood shavings were given. The results indicate that these litter materials contribute very little to the nitrogen and ash content of poultry manure samples and thus act as a diluting factor. Poultry manure can be an excellent source of minerals for livestock. The incidence of copper toxicity in sheep could be controlled by the inclusion of zinc at high levels in sheep rations. The results from the protein content survey proved the use of poultry manure as a nitrogen source. (Little-East Central)

5841-A6, B2 ODOR CONTROL AND BREAK- ING UP SOLIDS IN PITS BELOW SLOTTED FLOORS

D.J. Warburton and D.L. Day
Paper for University of Illinois Area Swine
Day, Jan. 19, 1978, 5 p. 1 tab., 5 ref.

Keywords: Liquid wastes, Odor control, Sampling

The effectiveness of commercially available odor control products for controlling odors and liquifying solids in liquid manure pits in confinement swine finishing buildings located in the Midwest climate were evaluated at the Illinois Agricultural Experiment Station. A controlled experiment was run testing 24 commercial products using a model of a manure pit so that the only variable was the commercial product added. This approach controlled all other variables as much as

possible giving objective information that should be reproducible under similar tests elsewhere. Favorable conditions for chemical additives were maintained throughout the test. The manure did not have excessive medications or antibiotics added. Normal temperatures were maintained. Samples were collected from the top two inches of the manure and put into black bottles. These were cleaned, the tops covered with cheese cloth and numbered for identification. The 24 samples were evaluated in the laboratory against two controls (manure from the drums with no additives), two waters or one of each. The odor strength was evaluated on a scale of 1-10 and odor acceptability on a similar scale. The need to evaluate both aspects of odor was important both from a nuisance standpoint and to avoid biasing against chemicals with more pleasant odors such as masking agents. To enable some evaluation of the effectiveness of individual products to increase solids liquification, a complete solids analysis was done. Total and volatile solids analyses were then conducted on the mixed sample, the settled sludge, the supernatant and a centrifugal sample of the supernatant. The final sample would give an estimate of the amount of dissolved and colloidal solids. The results on the effectiveness of these compounds for odor control and solids liquification is currently being analyzed. (Little-East Central)

5842-A11, C2, E3 EFFECT OF CORN SILAGE AND TURKEY LITTER ON THE PER- FORMANCE OF GESTATING PONY MARES AND WEANLINGS

University of Minnesota, St. Paul, Minnesota
R.M. Jordan
Journal of Animal Science, V. 49, No. 3, p.
651-653, Sept. 1979.

Keywords: Turkey litter, Refeeding, Horses, Performance, Nitrogen, Diets, Waste composition

The effects of feeding corn silage supplemented with pelleted turkey litter to 36 gestating pony mares and 12 weanlings were studied during a 2-year period. Supplementing corn silage with .21 kg to .26 kg of pelleted turkey litter per pony daily increased daily silage consumption in two of the three trials, significantly increased weight gains with mares and significantly reduced weight loss with 8-month-old ponies. Digestive difficulties were not encountered and no adverse effects on pregnancy occurred. (Jordan-University of Minnesota)

5843-A4, B2, C2 POTENTIAL NUTRITIONAL VALUE OF FUNGAL PROTEIN DERIVED FROM PIG SLURRY

The Queen's University of Belfast, Newforge
Land, Belfast BT9 5PX, Northern Ireland
A.E.J. McGill, D. Annette, and N. Jackson
Record of Agricultural Research, v. 26, p.
93-95, 1978, 2 tab., 14 ref.

Keywords: Swine wastes, Fungi, *Leptomyces lacteus*, *Mucor racemosus*, Slurries, Crude protein, Amino acids, Refeeding

Samples of mycelia of *Leptomyces lacteus* and *Mucor racemosus*, grown on both laboratory media and pig slurry, were analysed for crude protein and amino acid contents. Samples of the mycelia of both fungi were obtained from: (1) the polluted stream (2) fungal material cultured on stock media, and (3) fungal material grown on pig slurry. The two fungi examined from sources (2) and (3) can be considered to have moderately high protein levels. These two sources of amino acids could possibly be used to partially replace amino acids from other dietary sources. The crude protein content is a better indicator of the nutritive potential in the base of *L. lacteus* than for *M. racemosus*. The amino acid profiles of both fungi show a deficiency in the total concentration of the sulphur containing amino acids, when considered as possible amino acid sources for the diet of the growing pig or laying hen, this being most obvious in the case of the mycelia of *M. racemosus*. *L. lacteus* had a good lysine content from a nutritional standpoint, but availability was not determined. The potential nutritive value of the fungi is restricted because of the lack of information of their vitamin, mineral or energy contents. (Little-East Central)

5844-A11 ANTIBIOTIC RESISTANCE PATTERN OF SALMONELLA WELTEVERDEN STRAINS ISOLATED FROM MAN, ANIMALS, SEWAGE AND WATER

G.B. Pant University of Agriculture and Technology, College of Veterinary Medicine, Pantnagar, Nainital
K.N. Upadhyay and D.S. Misra
Indian Journal of Medical Research, V. 67, February, 1978, p. 212-216. 2 tab., 9 ref.

Keywords: *Salmonella welteverden*, Ampicillin, Chloramphenicol, Tetracyclines

The results of the study of antibiotic sensitivity pattern of 127 strains of *Salmonella welteverden* isolated from man, animals, sewage and water were given. Strains of human origin were resistant to more numbers of drugs than those of animal, sewage and water sources. All 127 strains of *S. welteverden*, irrespective of the source, were 100% resistant to bacitracin; all strains of this organism were sensitive to ampicillin and chloramphenicol. Comparative data of MIC levels of 60 strains against polymyxin B, tetracyclines, and chloramphenicol (25 ug/ml) revealed that high MIC level sensitive strains against tetracycline (250 ug/ml) and chloramphenicol were present only in human beings and not in animals and sewage. However, in the case of polymyxin B sulphate the percentage of high MIC level sensitive strains were more in sewage than in animal and human sources. (Little-East Central)

5845-C3, D3, E3, E4, F4 RECOVERY OF BY-PRODUCTS FROM ANIMAL WASTES--A LITERATURE REVIEW

Robert S. Kerr Environmental Research Laboratory, Ada, OK 74820

R.D. Kreis
Environmental Protection Agency Report, EPA-600/2-79-142, August, 1979, 59 p. 8 fig., 21 tab., 66 ref.

Keywords: Animal wastes, Gasification, By-product recovery, Ethylene, Methane, Hydrogasification, Anaerobic digestion

The primary purpose of this report was to identify and summarize by-product-from-animal-waste-recovery processes from the current literature. By-product recovery processes are distinguishable from wastes reuse and recycle processes by the formation of a chemically or physically changed product or by-product from the wastes as produced. Most of the schemes investigated were grouped into either biological or thermochemical processes. Methane production, a biological process utilizing anaerobic fermentation of the wastes, is receiving the greatest amount of popular and scientific attention. The economics of methane storage is the strongest deterrent to the development of this process for widespread application. Thermochemical processes investigated include conversion to oil and oil-like tars; anhydrous ammonia synthesis gas and ethylene; hydrogasification; manufacture of carbon black, carbon black substitutes, and fillers and foaming agents in foam glass construction materials; and other fuels and construction products. (Kreis-Robert S. Kerr Environmental Research Laboratory)

5846-A5, A8, B5, D1, E2, F1 SAFE DISPOSAL OF PIGGERY EFFLUENT ASSISTS EROSION CONTROL

J.H.N. Lee
The Journal of the Soil Conservation of New South Wales, V. 34, No. 3, p. 160-164, July, 1978. 6 fig.

Keywords: Economics, Waste disposal, Erosion control, Effluent, Soils, Infiltration, Management, Absorption, Recycling

Mayfair Farms, a large, highly intensified piggery on the outskirts of Sydney, Australia, sought the assistance of the Soil Conservation Service as a result of extension of the South West Freeway (F5) through the western side of the property. The extension of the freeway caused reduction in the available disposal area for effluent disposal by 20 hectares and brought the boundary in close proximity to a major thoroughfare. The piggery produces 2.3 million litres of effluent each week. After treatment which consists of: (1) separation, (2) settlement, and (3) aeration to extract most of the solids and gases the effluent is sprayed onto hilly grazing land adjacent to the piggery. To assist in the planning of the design and installation of a system of absorption banks to cope with the runoff and prevent further soil erosion, a soil survey was undertaken in conjunction with infiltration tests of the soils. The soil along the central ridge area is a red podzolic soil changing to a brown podzolic soil on the lower slopes and valleys. Average infiltration rates of the soils were: (1) Red podzolic-36mm, and (2) Brown podzolic-20mm. A contour survey of the disposal area was carried out to assist in the design of the scheme of absorption banks. It was decided that a system of banks at two-metre vertical intervals would have sufficient capacity to cope with the quantity of effluent being discharged from the piggery. The absorption banks provided a satisfactory method of disposing of effluent but changes in management were necessary to obtain the maximum benefit. (Stille-East Central)

5847-A5, A8 EFFECT OF CATTLE DUNG PATCHES ON SOIL TESTS AND BOTANICAL AND CHEMICAL COMPOSITION OF HERBAGE

Soil and Field Research Organisation, Ruakura Agricultural Research Centre, Ministry of Agriculture and Fisheries, P.B., Hamilton, New Zealand
W.C. Weeda
New Zealand Journal of Agricultural Research, V. 20, No. 4, p. 471-478, 1977. 6 fig., 3 tab., 5 ref.

Keywords: Phosphorus, Potassium, Nitrogen, Calcium, Magnesium, Potassium chloride, Soils, Leaching, Sampling, Sodium, Cattle wastes, Land application

Experiments were conducted on Horotiu sandy loam soil on a site south of Hamilton, New Zealand. The soil was low in potassium (0.4% of exchangeable K) but was high in phosphorus (Truog P - 14 top 7.6 cm). The effect of dung patches on soil test status was studied. Twenty-four simulated dung patches were used. Samples of the soil were taken 3 and 6 weeks and 2, 4, 6, 8, 12, and 18 months after dung applications. Under dung patches to a depth of 7.6 cm, the increase in Truog P was rapid and sustained. A rise in exchangeable K and Na was rapid, reaching a peak 1½ months after dung application, but was short-lived. Exchangeable Ca and Mg increased more slowly reaching a peak after four months. Dung decreased herbage Ca in both trials, and apparent recovery of faecal Ca in herbage was low. The downward movement of Mg under dung patches indicated that it could be leached. Application of KC1 depressed apparent recovery of faecal Mg and caused Mg losses. On soils requiring regular applications of KC1, loss of Mg could be appreciable under cattle grazing. (Little-East Central)

5848-B3, C1, E3 UTILIZATION BY SHEEP OF DRIED PIG FAECES CONTAINING A HIGH CONCENTRATION OF COPPER

School of Agriculture and Forestry, University of Melbourne, Parkville, Victoria, Australia
S. Hendrosekharjo and G.R. Pearce
Animal Feed Science and Technology, V. 3, p. 31-39, 1978. 4 tab., 17 ref.

Keywords: Swine wastes-dried, Refeeding, Copper, Molybdenum, Sulphate, Digestibility, Sheep, Diets, Performance, Crude protein, Sampling, Molasses

Pelleted diets were given to seven groups of three sheep as follows: A, 97% hay + 3% molasses; B, C, D, 82% hay + 3% molasses + 15% dried pig faeces; E, F, G, 67% hay + 3% molasses + 30% dried pig faeces. Because of the high concentration of copper in the faeces, assessments were made of the copper status of the sheep and attempts were made to reduce the chances of copper toxicity by additions of molybdenum and sulphate. Measurements were made of digestibility, copper retention, and plasma glutamic oxaloacetic transaminase (GOT) values during a 70-day feeding period, after which the animals were slaughtered. Dry matter digestibility coefficients were: diet A, 49.2; diets B, C, D, 44.4; diets E, F, G, 42.5, from which the coefficient for pig faeces alone was calculated

to be ≤ 30 . Over the 70 days, the mean copper retention ranged from 210 mg for diet A to 1225 mg for diet G (excluding diet E). Plasma GOT values varied within and between sheep throughout the experiment, with a maximum value of 182 units/ml. There were no significant differences in mean liver copper concentrations but there was a tendency for increasing proportions of dietary pig faeces to cause higher liver copper concentrations. In the sheep receiving diets containing 30% pig faeces, liver necrosis occurred more frequently. The kidneys from all sheep were apparently normal. It was concluded that the pig faeces were poorly utilized, and because of the high copper content, potentially hazardous to the health of the sheep. (Little-East Central)

5849-B3, C2, D3, E3, F1 METHANE GENERATION FROM MANURE, MUNICIPAL SOLID WASTES, AND LANDFILL DI- GESTION

Department of Mechanical Engineering,
Engineering Research Institute, Iowa State
University, Ames, Iowa
G.M. Colver
ISU-ERI-Ames-78214, April, 1978, 28 p. 5
fig., 3 tab., 17 ref.

Keywords: Biodegradation, Methane, Carbon
dioxide, Animal wastes, Hydrogen sulfide,
Ammonia, Nitrogen, Dilution, Decomposition,
Volatile solids, Digesters, Mesophilic, Ther-
mophilic, Equipment, Detention time, Tem-
perature, Economics, Liquefaction, Adsorp-
tion, Slurries

The biological phenomena in the digestion of manure involves the slow-decomposition of organic waste to give off bio-gas which typically consists of 50-75% methane and 50-25% carbon dioxide. Most digesters operate on a semi-continuous basis by adding fresh manure and removing digested manure daily. Operational energy requirements for the digester include: (1) heating the influent slurry to the mesophilic temperature ($\sim 90^\circ\text{F}$), (2) heat conduction losses through digester walls, and (3) work for pumping and digester mixing. Gas purification equipment may be required if pipeline quality and low corrosive gas is required. The following variables directly or indirectly affect the slurry production of methane (bio-gas): (1) temperature, (2) pH, (3) detention time, and (4) digester completeness of mixing. Advantages of methane generation from manure are: (1) It is basically a simple operation, (2) Detention time is relatively short, and (3) Sludge is odor-free, does not attract flies, and is potentially useful as a fertilizer and as a fuel. Disadvantages of methane generation from manure are: (1) Digester performance is sensitive to the seasons, (2) Bio-gas is diluted with gaseous impurities, and (3) Methane is not conveniently stored and is explosive since it does not liquify at convenient temperatures and pressures. Recommendations for best digester performance are: (1) fresh manure should be ingested immediately, (2) the digester product, H_2S , should be removed as soon as possible from the bio-gas to prevent corrosive action on pipes, pumps, etc. Thermophilic (140°F) digestion may give higher daily yields of methane, as compared to mesophilic (90°F) temperatures, although any gains may be more than offset by the additional heating losses which would occur at the higher operating temperatures. (Stille-East Central)

5850-A11, C2, D1, E3, F1 THE USE OF DPW AT VARYING LEVELS IN CATTLE FATTENING RATIONS

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Maidstone, 4380
J. Kargaard and B.D.H. van Niekerk
South African Journal of Animal Science, V. 8,
p. 143-147, 1978. 5 tab., 8 ref.

Keywords: Poultry wastes-dried, Perfor-
mance, Economics, Refeeding, Cattle, Crude
protein, Calcium, Phosphorus, Dehydration

The effects of including DPW, at four different dietary levels, on the performance of feedlot cattle were investigated in order to establish if lower levels of inclusion might not give more favourable results. A 4×2 factorial arrangement testing four levels of DPW in combination with either sunflower oilcake meal or urea was used. Results from this study showed that virtually no differences were recorded in animal performance between cattle on sunflower oilcake meal or urea. The inclusion of DPW resulted in a depression in animal performance, although this depression was only significant ($P \leq 0.01$) at the 12% level. Although the inclusion of DPW tends to depress animal performance, the saving in ration costs is such that even at the 12% level of inclusion, DPW is still economically justified when compared with sunflower oilcake meal. (Little-East Central)

5851-B3, C2, E3, F1 UNDER-USED PRODUCTS FROM CROPS AND ANIMALS

National Institute for Research in Dairying,
Reading, Berkshire, England
A.S. Foot
Philosophical Transactions of the Royal So-
ciety of London, V. 281, p. 221-230, 1977. 4
tab., 23 ref.

Keywords: Refeeding, Poultry wastes, Phos-
phorus, Calcium, Diets, Ash, Nitrogen,
Economics, Poultry wastes-dried, Earth-
worms

Under-use of agricultural products may take the form of (1) dumping or burning products which still have value as fuel or as a source of plant nutrients; (2) returning them to the land when they could be used for animal feeding; (3) feeding them to animals when they could be eaten by the human consumer. In considering under-use of livestock excreta, perhaps the first point to assess is whether the same species of livestock producing the excreta, or a different species of livestock, can extract more feed nutrients. Most of the work on recycling excreta has involved dried poultry manure. It has been shown that dried poultry manure may be of value as a protein source in broiler diets and have some value in diets for laying hens and replacement pullets. There is also evidence that dried poultry manure may have a commercial value in ruminant diets. However, there have been worries about the possible transfer of pathogens, heavy metals, and drug residues and some driers have been stopped because of odour problems. Some attempts have been made to assess the value of cattle excreta when recycling through ruminants. Work has also been done using faeces from dairy cattle as a medium for growth of earthworms and using sheep and poultry excreta as a medium for growing the tigerworm. It is clear that

processing, storage and distribution of animal wastes on the farm involve substantial losses of plant nutrients to the atmosphere, to land drains, watercourses and to groundwater. There is a large pool of animal nutrients in the form of livestock excreta but the prospect of recovering these for animal feeding in the immediate future seems to be centered mainly on dried poultry manure and even here considerable technical problems remain. (Stille-East Central)

5852-A11 EFFECTS OF LEVEL OF FEED INPUT, DILUTION OF TEST MATERIAL, AND DURATION OF EXCRETA COLLECTION ON TRUE METABOLIZABLE ENER- GY VALUES

Animal Research Institute, Agriculture
Canada, Central Experimental Farm, Ottawa,
Ontario, Canada K1A 0C6
I.R. Sibbald
Poultry Science, V. 58, No. 5, p. 1325-1329,
Sept., 1979. 5 tab., 11 ref.

Keywords: Poultry wastes, Dilution, Feeding-
stuffs, Waste collection, Crude protein, Dry
matter, Performance

Adult, Leghorn cockerels were used in two bioassays designed to study the effect of 24 and 48 hour excreta collection periods on true metabolizable energy (TME) values of feeding-stuffs. In the first experiment, four feeding-stuffs were each evaluated at input levels of 10, 20 and 30 g/bird. In the second assay three feedingstuffs were fed alone and as blends with a carrier. A reduction in TME value associated with extension of the excreta collection period was evidence that feed residues had not cleared the alimentary canal within 24 hours. Residues of wheat and of the carrier cleared the canal within 24 hours while those of fish meal were almost cleared. Residues of dehydrated alfalfa and, to a lesser extent, meat meal required a longer period. Varying input levels, and dilution with a carrier, had minor effects on clearance times. It is concluded that the duration of the excreta collection period must be adjusted according to the rate of passage of the material being assayed. Reduction in input or blending with a carrier were not satisfactory solutions to the problems of slow residue clearance. (Sibbald-Animal Research Institute)

5853-A3, A4, A8, B2, C1, C2, C3, D3, F1 LIVESTOCK FEEDLOT RUNOFF CONTROL BY VEGETATIVE FIL- TERS

University of Illinois, Urbana, Illinois 61801
D.H. Vanderholm, E.C. Dickey, J.A. Jackobe,
R.W. Elmore, and S.L. Spahr
Environmental Protection Agency Report
EPA-600/2-79-143, Aug., 1979, 78 p. 31 fig.,
14 tab., 15 ref.

Keywords: Feedlot runoff, Vegetative filters,
Overland flow, Channelized flow, Economics,
Nitrogen, Potassium, Solids, Sampling

Vegetative filters were installed to treat runoff from two beef feedlots, one dairy lot, and one

swine feedlot in central Illinois. Two configurations were used - channelized flow and overland flow. Runoff underwent settling for partial solids removal and was then applied directly to vegetative filter area. Runoff from most smaller rainfall events infiltrated completely, resulting in no discharge. Runoff analysis indicated a removal of over 95 percent of nutrients and oxygen demanding materials on mass balance basis and over 80 percent reduction on a concentration basis when compared to runoff applied to the filter area. Discharge rates were very low and minimal dilution was necessary to meet state water quality standards. Design criteria were developed for overland flow and channelized flow systems. The proposed criteria would completely infiltrate runoff from small storm events and provide adequate treatment for discharge during larger events. (Vanderholm-University of Illinois)

5854-A6, A11, B3, C2, D3, E2, E3, F1 NO-WASTE WASTE

Anonymous
The Furrow, V. 84, No. 7, p. 34-35, Sept.-Oct., 1979. 3 fig.

Keywords: Swine wastes, Algae, Fish, Irrigation, Fertilizers, Poultry wastes, Poultry wastes-dried, Cattle wastes, Composting, Nitrogen, Phosphate, Potash, Economics, Soils, Dehydration, Effluent

Livestock feeders and researchers are finding some unusual ways to make better use of manure. One way is the use of swine manure to grow algae for feed in Russell Grant's 4,000-head custom hog operation near Ellinwood, Kansas. Grant uses six 1½ acre ponds filled to a depth of three feet (effluent collects in one pond and fast growing algae is raised in the other five). Algae are drawn off and the water is returned to the same pond. The algae is then fed to the hogs at a rate of about one gallon per day per hog, and at a cost of one to two cents per pound. One gallon of algae soup averages about two pounds of protein requirements. Another unusual way livestock feeders and researchers are finding to make better use of manure is also feeding swine waste to algae. However, in this case the Tennessee Valley Authority's National Fertilizer development Center, Muscle Shoals, Alabama has the algae pond stocked with two species of carp and Nile perch to help shorten the food chain and make maximum use of nutrients in the manure. The pond water is pumped on to sand beds to irrigate and fertilize Chinese chestnuts which in turn helped clean up and improve the water through sand-bed filtration and nutrient uptake. One final way livestock feeders and researchers are finding to make better use of manure is in Missouri where cattle farmers are already feeding poultry waste and are beginning to feed composted or dehydrated poultry waste to their cattle. The compost is odor-free and can also be spread on fields as fertilizer. A finished ton of dry compost contains about 40 pounds of nitrogen, phosphate, and potash, along with trace elements. According to Leon Chessenin, University of Nebraska Agronomist, feedlot operators are recognizing that manure is a valuable resource which in the past has been wasted or used improperly. The challenge is to find the most profitable way to make waste work for them. (Stille-East Central)

5855-A11, D2, E2 LIMITATIONS OF GUIDELINES GOVERNING RATES OF APPLICATION OF PIG MANURE TO LAND

School of Agriculture and Forestry, University of Melbourne, Parkville Victoria, Australia
E.P. Hillard and G.R. Pearce
Agriculture and Environment, V. 4, 1978, p. 65-75. 5 tab., 18 ref.

Keywords: Swine waste, Loading rates, Soils, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sodium, Iron, Zinc, Copper, Cadmium, Lead, Arsenic, Aerobic, Anaerobic, Crude protein, Ammonium, Ammonia, Nitrates, Hydrogen phosphate, Slurry, Irrigation, Volatilization, Diets

Loading rate limitations of application of pig manure to land were examined to existing concepts for calculating manure application rates to land. Samples of diets and faeces were collected from 24 piggeries in the Bendigo-Shepparton area of Victoria, Australia. Concentrations of each element in manure were calculated from the estimated daily excretions. The comparison of the estimated concentrations of elements in the manure with the results of faecal samples indicate that the estimates are of the correct order, allowing for the fact that large proportions of nitrogen and of the mineral macro-elements are excreted in the urine. On the basis of the analyses of diets from the 24 commercial piggeries and supported by analyses of pig faeces derived from those diets, it is certain that a wide variability occurs under practical conditions in the composition of pig manure available for disposal on to land. Rates of application of manure to land can be pre-determined from a knowledge of the dietary concentrations of any particular element. It is evident that a great deal of additional information is required on the effects on soils, plants and animals of applying large quantities of pig manure; this applies particularly to the effects of high loadings of heavy metals which can occur under some conditions. Although these may not be serious hazards under well-managed land application situations, overloading of soil especially to the extent of inducing direct run-off or seepage into waterways, may be much more critical. (Stille-East Central)

5856-B1, C2 OBSERVATIONS ON THE CORRELATION BETWEEN THE DUNG DISPOSAL SYSTEMS AND THE CONCENTRATION OF AMMONIA IN THE AIR OF ANIMAL HOUSES

Department of Animal Hygiene of the Timisoara, City Faculty of Veterinary Medicine, Romania
V. Tomescu and F. Marschang
British Veterinary Journal, V. 133, p. 629-634, 1977. 2 tab., 20 ref.

Keywords: Carbon dioxide, Ammonia, Waste disposal, Cattle wastes, Slatted floors, Ventilation

During the period 1969 to 1973 researchers determined the concentration of carbon dioxide and ammonia in buildings housing

dairy cows, new-born to six-month-old calves and young and old beef cattle. The variation in carbon dioxide levels was much less than that of ammonia. The lowest ammonia concentrations were found in the houses where evacuation was performed through slatted floors. The reasons for the reduction of noxious gas concentrations in animal houses with slatted floors were further examined. The ability of other dung disposal methods to restrict the production of noxious gases to low concentrations largely depends on the quantity and quality of the litter used. It was concluded that the maintenance of a healthy microclimate requires an efficient ventilation system combined with satisfactory dung disposal and that slatted floors are an important contribution to the maintenance of pure air conditions in animal houses. (Little-East Central)

5857-B3, C2, E3 PROCESS CONTROL OF ANAEROBIC DIGESTION FOR SCP RECOVERY

University of Newcastle-upon-Tyne, England
K. Thomas and L. Evison
New Processes of Wastewater Treatment and Recovery, 1978. 4 fig., 14 tab., 19 ref.

Keywords: Swine wastes, Volatile fatty acids, Methanogenesis, pH, *C. utilis*, Digesters, Single cell protein

The feasibility of inhibiting methanogenesis in digesting pig waste, to produce an effluent with a high concentration of Volatile Fatty Acids (VFA) and investigate its suitability as a substrate for yeast growth was studied. The following means of inhibition of methanogenesis were investigated: (1) Induce low pH in digesters naturally, by overloading, (2) Induce low pH in digesters artificially, by the addition of HCl to the feed, and (3) Kinetic control in contact digester operation to provide optimum conditions for acidogenic bacteria and inhibition and washout of methanogenic bacteria. Low pH conditions did reduce methanogenesis dramatically. The mixture of volatile fatty acids, alcohols and ketones produced did form a suitable substrate for *C. utilis* but it is possible that propionic acid could be inhibitory, and high concentrations of acetic acid could cause substrate inhibition. Closer control of the digestion process can be achieved by contact digestion with solids recycle and short liquid retention times. The high solids concentration, high alkalinity and high ammonia concentrations of pig waste have caused some problems. However, results show that controlled acidogenesis is possible even with pig waste. (Little-East Central)

5858-A11, B5 TISSUE RESIDUES OF STEERS GRAZED ON WHEAT PASTURE TREATED WITH INDAR SYSTEMIC FUNGICIDE

Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma 74074
G.W. Horn, F.P. Horn, W.R. Lyman, and D.G. Wagner

Keywords: Fungicides, Performance, Forages, Sampling, Pastures, Indar, Animal health

Residues in tissues (skeletal muscles, fat, liver and kidney, and fecal and urine grab samples) of steers that grazed an INDAR fungicide-treated wheat pasture for 4 weeks, and after 1- or 3-week withdrawal periods of grazing a non-treated wheat pasture were measured. INDAR parent compound (4-buty1-4H-1, 2, 4-triazole) concentrations ranged from 35 to 71 ppm of forage dry matter during the initial 4-week period and were higher than those that would be expected with normally recommended applications of INDAR fungicide. No effects of INDAR fungicide on steer grazing behavior or general alertness were observed. Total residue concentrations (INDAR fungicide and its metabolites or degradation products having the 1, 2, 4-triazole ring) in skeletal muscle, fat, liver and kidney samples averaged .50, .17, .84 and .57 ppm, respectively, at the end of the initial 4-week period on the treated wheat pasture. Tissue residues after a 3-week withdrawal period, and fecal and urine residues after 1- or 3-week withdrawal periods were not different ($P > .05$) from those of steers that grazed the nontreated pasture during the initial 4-week period. The data show that tissue residues of INDAR fungicide declined rapidly after stocker cattle are removed from the fungicide treated pasture and would be expected to be extremely low in cattle from wheat pastures that received normal applications of the fungicide. (Horn-Oklahoma Agricultural Experiment Station)

5859-B3, C2, D3, E3 FERMENTATION CHARACTERISTICS AND NUTRITIONAL VALUE OF ENSILED CAGED LAYER WASTE AND CORN FORAGE

M.H. Albert, J.P. Fontenot, and K.E. Webb, Jr.
Livestock Research Report, Research Division Report 172, July, 1977, p. 82-89. 6 tab.

Keywords: Poultry wastes, Refeeding, Ensiling, Bacteria, Crude protein, Acetic acid, Butyric acid, Isobutyric acid, Sheep, Silages, pH, Lactic acid, Waste disposal

Studies were conducted to investigate the feasibility of ensiling different mixtures of caged layer waste and corn forage as measured by fermentation characteristics and ration digestibility by sheep. The composition of the initial mixtures and silages for the small silos was given. Each addition of caged layer waste increased ($P < .01$) dry matter, crude protein and ash content of the silages. Following fermentation, final pH values of the silages decreased, but pH values were higher ($P < .01$) with each level of waste addition. Lactic acid levels were higher ($P < .01$) for the waste containing silages. Total bacteria counts were reduced, and coliforms were completely eliminated by ensiling. Both total bacteria and coliform counts were reduced in the large silos, but not to the levels found in the small silos. *Proteus* organisms were destroyed in the small silos by ensiling. The amount of soybean meal added to the corn silage in an attempt to equalize the protein content of the 80:20 corn forage - waste silage was overestimated, resulting in a higher crude protein content than desired. Crude protein

digestibility increased with each level of waste addition, while digestibility of other components generally decreased with each waste addition. Ruminant ammonia and blood urea levels increased with each addition of caged layer waste, when compared to the corn silage ration. Acetic, butyric, isobutyric and total acid levels were higher ($P < .01$) for the lambs fed the corn silage-soybean meal ration when expressed as u moles/ml than for the other lambs. Propionic, valeric and isovaleric were lower ($P < .01$) for the lambs fed the 80:20 ration, compared with the other rations. Butyric was lower ($P < .01$) for the lambs fed the 60:40 ration when expressed as moles/100 moles. Lambs fed both waste containing rations had higher ($P < .01$) propionic acid. (Little-East Central)

5860-B1, C2, D2, D3, E3 ENSILING CHARACTERISTICS OF VARYING COMBINATIONS OF SWINE FECES AND GRASS HAY AND THE UTILIZATION OF ENSILED SWINE FECES GRASS HAY BY RUMINANTS

J. Berger, E.T. Kornegay and J.P. Fontenot
Livestock Research Report, Research Division Report 172, July, 1977, p. 145-150. 6 tab.

Keywords: Swine wastes, Fermentation, Ensiling, pH, Lactic acid, Digestibility, Nitrogen, Crude protein, Diets, Refeeding, Coliforms

This study was conducted to determine: (1) fermentation characteristics of different levels of swine feces when ensiled with ground orchard grass hay and (2) the acceptability and nutritive value of swine feces and orchard grass hay silages when fed to ruminants. Good ensiling occurred with 70:30 to 40:60 mixtures of feces and hay, when swine feces and ground orchard grass hay were ensiled in varying proportions in small laboratory type silos. The lactic acid values were acceptable and pH values of less than 5 were obtained. Values for lactic acid were especially high for the 60:40 to 30:70 mixtures of feces and hay. After ensiling there were large reductions in total bacteria and coliforms and complete destruction of fecal coliforms. The feces-hay silages were well utilized by growing sheep as a result of the digestibility and acceptability trials conducted with ensiled mixtures of 60:40 and 40:60. Digestibility of the organic matter and crude protein components in the silages were equal, if not greater, than the digestibility of these components in the orchard grass hay diet, the organic grass hay plus soybean diet, the organic matter and crude protein elements were more digestible than those of the orchard grass hay diet and the silage diets. Nitrogen retention was poorest for sheep fed the two silage diets as compared to the hay diet or hay plus soybean meal diet. (Little-East Central)

5861-A11, B3, E3 MINERAL PROFILES IN BROILER LITTER AND IN LIVER AND LOIN FROM FINISHING HEIFERS FED ENSILED BROILER LITTER AND CORN FORAGE

T.W. Weesting, J.P. Fontenot, K.E. Webb, Jr., and W.H. McClure
Livestock Research Report, Research Division Report 172, July, 1977, p. 101-106. 3 tab.

Keywords: Poultry litter, Cattle, Refeeding, Diets, Arsenic, Bromine, Cadmium, Copper, Molybdenum, Vanadium, Zinc, Performance

Corn forage was ensiled alone or with broiler litter at 30% of the dry matter. Eight lots of six beef heifer calves each were group fed for 201 days. Each of two pens were fed: (1) ensiled corn forage and broiler litter (70:30, dry basis); (2) ensiled corn forage and broiler litter (70:30) and supplemented with soybean meal; (3) ensiled corn forage; (4) ensiled corn forage and supplemented with soybean meal. All lots were supplemented with concentrates at 1% of bodyweight. Profiles on 43 mineral elements were obtained by neutron activation of ration components and liver and loin eye muscle. Mineral profiles were higher for arsenic, bromine, cadmium, copper, molybdenum, vanadium and zinc in broiler litter compared to other feedstuffs. Broiler litter showed high levels for copper and cadmium. Liver copper values were elevated ($P < .05$) in heifers fed broiler litter. Bromine values were lower ($P < .05$) in loin and liver and zinc liver values were lower from broiler litter fed heifers. Heifers fed broiler litter showed no evidence of toxicity as indicated by performance and physical observation. (Weesting)

5862-A11, D1 FACTORS AFFECTING THE SURVIVAL OF *TREPONEMA HYODYSENTERIAE* IN DYSENTERIC PIG FAECES

Department of Veterinary Pathology, University of Glasgow Veterinary School, Bearsden Road, Bearsden, Glasgow

S.P. Chia and D.J. Taylor
Veterinary Record, V. 103, p. 68-70, July 22, 1978. 4 tab., 7 ref.

Keywords: Swine wastes, *Treponema hyodysenteriae*, Temperature, Disinfectants, Dilution, Dehydration

This study was conducted to provide information on the ability of *Treponema hyodysenteriae* to survive in dysenteric pig faeces under conditions likely to be found on farms. The effects of drying, temperature, dilution with tapwater and exposure to disinfectants on the survival of *T. hyodysenteriae* in dysenteric faeces were studied. The faecal samples were obtained direct from the rectum and were infected with pure cultures of *T. hyodysenteriae* within one hour of collection. *T. hyodysenteriae* was found to survive for long periods in undiluted faeces stored at temperatures between 0°C to 10°C but survival at 20° to 25° C was markedly reduced. It had been thought that the dilution of faeces with tapwater might kill the organism by osmotic disruption but this proved not to be the case. The effect of drying on the recovery of *T. hyodysenteriae* from faeces was noted. It is likely that the drying was responsible for the rapid disappearance of *T. hyodysenteriae* from these samples. All disinfectants tested were effective in preventing the culture of *T. hyodysenteriae* from dysenteric faeces at the dilutions recommended for use. The most effective disinfectants appeared to be phenol (white Septol B) and Sodium hypochlorite solution (Chlorox) which had similar minimal inhibitory concentrations in the conditions used in this study. The ability of *T. hyodysenteriae* to

survive up to 61 days in faeces diluted with water suggests that all slurry and manure should be removed from premises which are to be restocked with the susceptible pigs after buildings have been cleaned in a depopulation program. (Stiles-East Central)

5863-A2, A4, A8, E2 **ISOLATION OF ANIMAL VIRUSES FROM FARM LIVESTOCK WASTE, SOIL AND WATER**

Department of Veterinary Microbiology and Immunology, University of Guelph, Ontario Canada N1G 2W1
J.B. Derbyshire and E.G. Brown
Journal of Hygiene, V. 81, No. 2, 1978, p. 295-302. 2 tab., 29 ref.

Keywords: Swine wastes, Cattle wastes, Soils, Land application, Viruses, Surface runoff

This paper described attempts to isolate viruses from pig and cattle slurry, from soil samples, from land on which pig slurry has been spread, and from samples of surface runoff, surface water and groundwater collected on farms where pig slurry was routinely spread on agricultural land. Also examined were samples of surface run-off collected at cattle feedlots. The major source of positive samples was slurry collected from the swine fattening house. No virus was isolated from 12 samples of slurry from dairy cows nor from six slurry samples from a calf-rearing unit. Two bovine enteroviruses were isolated from cattle feedlot run-off after adsorption to layers of talc and celite followed by hydroextraction. It was shown that pig slurry may contain significant amounts of porcine enteroviruses, and that these may retain their infectivity for several days when applied to agricultural land, and find their way into surface water supplies, presumably by elution from the soil by rain water. This could provide opportunities for the spread of viral infection among livestock, and might play a significant role in the epidemiology of certain viral diseases of animals. (Stiles-East Central)

5864-A11 **COMPARATIVE VIRULENCE AND IMMUNODIFFUSION ANALYSIS OF PETRIELLDIUM BOYDII (SHEAR) MALLOCH STRAINS ISOLATED FROM FEEDLOT MANURE AND A HUMAN MYCETOMA**

Research Station, Agriculture Canada, Lethbridge, Alta., Canada T1J 4B1
R.G. Bell
Canadian Journal of Microbiology, V. 24, No. 7, p. 856-863, 1978. 4 fig., 22 ref.

Keywords: Feedlot wastes, *Petrielidium boydii*, Immunodiffusion, Animal health, Antigens, Spores

The virulence of a manure strain of *Petrielidium boydii* was compared with that of one isolated from a human mycetoma and the possibility of differentiating between the two by immunodiffusion was investigated. Non-inbred female albino Swiss mice were injected

intraperitoneally with washed spores suspended in 5% hog gastric mucin. The higher virulence of the mycetoma strain was evident both in the speed with which mortality first occurred, two days vs. six days, and in the total mortality observed over the 21-day test period, 95% vs. 28%. The most striking symptom of experimentally produced petriellidiosis in mice was the torticollis. *P. boydii* was detected in the brain as well as in the organs of the peritoneal cavity, the site of inoculation, which indicated that the infection was disseminated throughout the animal perhaps by the thoracic duct. Soluble antigen preparations with concentrated antisera produced in rabbits using live spore suspensions were used in immunodiffusion analyses. The proportions of the two strains were significantly different, but they did contain common antigens. (Little-East Central)

5865-B1, C2, D3, E3, F1 **IS GAS FROM MANURE PRACTICAL TO PRODUCE AND USE?**

F.J. Giesler
Hoard's Dairyman, p. 40-41, Jan. 10, 1975.

Keywords: Anaerobic digestion, Economics, pH, Animal wastes, Waste disposal, Waste management

Don D. Jones, Purdue University agricultural engineer, believes there is a tremendous potential in energy production from livestock wastes, but technical improvement and a sophisticated management level are needed to make the process economically practical. Anaerobic digestion, a biological phenomenon involving two distinct kinds of bacteria, working in a very delicate balance, is the process used for fuel production from livestock wastes. Anaerobic digestion is not particularly efficient and is not economically competitive. Factors which must be considered in anaerobic digestion are supplemental heat to maintain high digester temperatures, high capital costs, and high management requirements. (Stiles-East Central)

5866-B2, C1, C2, C3, D3, E3 **STUDIES ON THE BIOGAS PRODUCTION FROM SEVERAL ANIMAL FECES**

Laboratory of Dairy Technology and Microbiology, College of Agriculture, Seoul National University, Suwon, South Korea
I.K. Kwon and H.U. Kim
Korean Journal of Animal Science, V. 20, No. 3, p. 233-242, 1978. 7 fig., 7 tab., 12 ref.

Keywords: Animal wastes, Biogas, Sodium hydroxide, Temperature, Methane, pH, Waste composition, Ash, Crude protein, Equipment-generator, Anaerobic

In order to maximize the methane production from several animal feces, various parameters have been studied for their optimum values. The fecal material tested includes manures of pigs, chicken, and cows. When we inoculate the fresh tank with old tank sediment which was supposed to contain large numbers of methane bacteria, we could not increase the total volume of methane produced but could intensify the methane production within faster and shorter period of time and the pH stabilization could be achieved more easily

within shorter length of time. Predigestion of fecal material did not seem to increase the methane production efficiency as far as concerned with those animal feces tested. Total average methane production (scrubbed once through 1N NaOH solution) per one gram of fecal organic matter is 235.3ml for cow feces, 418.0ml for pig feces, and 590.6ml for chicken manure. After replaced 30% of the tank material with fresh manure (5% organic matter), the peak gas production was reached within 20-30 hours and the optimum pH appeared to lie between pH 6.5 and pH 7.5. When the tank temperature was lowered from 35°C to 20°C, methane production rate was diminished at a ratio of 1:10 and accordingly pH was decreased. After several days of this temperature lowering, the methane production rate could be easily recovered if the temperature is increased back to 35°C, which means methane production could survive the intermittent temperature shock. For the winter management of methane tank especially during cold Korean winter, the cheap solar collector is being tested to warm the tank within the vinyl house. (Kwon-Seoul)

5867-B3, C2, D1, E3 **STUDIES ON THE RECYCLING OF ANIMAL WASTE. VI. INVESTIGATION OF NUTRIENT COMPOSITION IN THE WASTE**

Livestock Experiment Station, Suwon, South Korea
Y.H. Chang, T. H. Kang, and In. K. Han
Korean Journal of Animal Science, V. 20, No. 1, p. 82-89, 1978. 3 tab., 25 ref.

Keywords: Recycling, Animal wastes, Waste composition, Dehydration, Crude protein, Ash, Potassium, Iron, Amino acids

The waste of laying hen, Korean native cow, dairy cow, and swine were collected at the Livestock Experiment Station, dried at 60°C in drying oven, and analyzed for investigating their nutrient composition. The results obtained were as follows: (1) The crude protein contents in layers waste were 21 to 33% of air dry matter, which were 38 to 94% higher than those in rations the layers consumed. However, the levels in feces of Korean native cow, dairy cow and swine were similar to the value in their concentrate rations. (2) The nitrogen-free extract contents in poultry or animal waste were considerably low. The values in layers corresponded to 40% of those in their rations. The relative value of waste to concentrate ration for other animals were 65%. (3) The poultry or animal waste contained much amount of non-protein nitrogenous compound, corresponding to about 40% of total crude protein. (4) The crude ash contents in layers manure were 16 to 30% of air dry matter and those in feces of Korean native cow, dairy cow and/or swine were 10 to 19%. (5) Both poultry and animal waste were characterized to contain high levels of potassium and iron. (6) Viewing the amino acid contents in poultry or animal waste it was shown that they contained high levels of methionine, lysine, aspartic acid, threonine, glutamic acid, glycine and leucine. (7) The amino acids contents in waste of layers, Korean native cow and dairy cow were similar to or lower than those in wheat bran. However, those in swine manure were similar to or higher than those in wheat bran. (Chang-Livestock Experiment Station)

**5868-A11, B3, C2, D1, E3, F1
STUDIES ON THE RECYCLING
OF ANIMAL WASTE. IV. STUDIES
ON THE NUTRITIVE VALUE
OF DRIED POULTRY WASTE
AND DRIED COW MANURE FOR
GROWING-FINISHING SWINE**

College of Agriculture, Seoul National University, Suwon, South Korea
In K. Chung, M.K. Yoo, In K. Han, and C.Y. Chung
Korean Journal of Animal Science, V. 19, No. 2, p. 103-108, 1977. 6 tab., 11 ref.

Keywords: Recycling, Animal wastes, Poultry wastes-dried, Cattle wastes-dried, Swine, Performance, Digestibility, Dry matter, Crude protein, Economics, Carcass quality

Thirty-five crossbreds between Landrace and Large white or Hampshire were employed to investigate the effect of feeding 0%, 10%, 20%, 30% of dried poultry waste and dried cow manure to growing-finishing swine. The results obtained are summarized as follows: (1) It was found that daily gain, feed consumption and feed efficiency were slightly depressed as the level of the substitution of dried animal wastes for wheat bran increased. (2) Carcass characteristics were not significantly affected by feeding dried animal wastes up to 30%. However, data indicated that backfat thickness was thinner for animals fed dried animal wastes than control group. (3) Digestibility of dry matter and crude protein decreased as the level of dried animal wastes in the rations increased, but digestibility of other nutrients were not shown to be affected. (4) Feed cost required per kilogram of body weight gain was less expensive in control group than the other animal wastes group. It could be concluded that dried animal wastes may be used in growing-finishing swine rations up to 10% without any adverse effects. (Chung-Seoul National University)

**5869-A8, C1, C2, D3, E2
A NONPOINT SOURCE MODEL
FOR LAND AREAS RECEIVING
ANIMAL WASTES: I. MINERALIZATION OF ORGANIC NITROGEN**

Assistant Research Scientist, University of Florida, Sanford, Florida
K.R. Reddy, R. Khaleel, M.R. Overcash, and P.W. Westerman
Transactions of the ASAE, V. 22, No. 4, p. 863-872, July-August, 1979. 2 fig., 5 tab., 43 ref.

Keywords: Animal wastes, Nitrogen, Mineralization, Model, Soils, pH, Land application, Nonpoint sources, Waste disposal, Land application, Temperature, Moisture content, Decomposition

A simple model based on current state-of-the-art was developed to describe the nitrate accumulation in land areas receiving animal wastes or plant residues. Earlier models using decay series were useful in predicting long term mineralization, but are less precise in determining the actual rate of mineralization or are less useful in transferring to other wastes which have not been studied. Utilizing the waste characteristics (C/N) and the soil nitrogen content, the model developed can be

used to estimate the total potentially mineralizable N after the application of a waste to soil. This value is an asymptotic inorganic N yield achieved over the long term. Assuming a first-order kinetics for mineralization, the rate constants based on available literature were developed. It was concluded that about 50 percent of the N available for mineralization was converted in 3 to 6 wk for poultry and swine wastes. In comparison, beef wastes required approximately 18 wk under similar conditions. For wastes with C/N greater than 23 a lag period occurs as a carbon is metabolized and lost, after which mineralization occurs with a rate constant of about 0.0077/day (at 35°C). Correction factors were developed for the major soil and environmental parameters affecting the mineralization rate. These factors were soil temperature, soil moisture, soil pH, and method of application of the waste. (Reddy-University of Florida)

**5870-A2, B2, C1, C2, D3
RUNOFF CONTROL COMPARISONS FOR COMMERCIAL BEEF CATTLE FEEDLOTS**

USDA-SEA-AR, Lincoln, Nebraska
C.B. Gilbertson, J.A. Nienaber, J.L. Gartung, J.R. Ellis, and W.E. Splinter
Transactions of the ASAE, V. 22, No. 4, p. 842-848, 849, July-August, 1979. 5 tab., 21 ref.

Keywords: Feedlots, Runoff control, Sediment basins, Conveyance channels, Holding ponds, Waste disposal, Moisture content, Total solids, Volatile solids, pH, Nitrogen, Phosphorus, Chemical oxygen demand, Effluent, Soil conditioning, Manure pumps, Aeration

A runoff control system was installed under EPA sponsorship on the L.P. Schram Feedlot, Papillion, Nebraska, to determine runoff characteristics from a large feedlot, and the adequacy of current runoff control system design criteria. System components were sediment basins, conveyance channels, holding ponds, and disposal system. The quantity of runoff during this study was 73 percent of that reported for small feedlots. However, about 30 percent below normal annual precipitation and relatively light snowmelt explain this discrepancy. The amount of settled solids removed from the sediment basins varied during cleaning, but was greater than that recorded in literature. The quantity of settled solids removed from basins located within the lots ranged from 21 to 62 kg/m³ of runoff compared to 14 to 58 kg/m³ for basins located outside the lots. A considerable quantity of material was removed from fencelines where sediment basins were located outside the feedlot. Sediment generally had a higher moisture content in basins inside the lot than in basins outside the lot. During dry weather, however, inside-lot basins dried faster than those outside, due to the continual aeration caused by cattle movement about the lot. The total solids content of the holding pond was 25 percent below that of published values. All values for total and volatile solids, electric conductivity, pH, nitrogen, phosphorus, and COD were within published ranges. The design of runoff control components (sediment basins, holding ponds, and disposal systems) must be tailored to individual operations. General design for periods expected over a 10-yr period, interaction of system components to reduce change of overflow, and resulting pollution potential of the feedlot. Sediment basin capacity depends on location with respect to the holding pond

and the pollution potential of the lot. A design capacity of 314 m³/ha of feedlot is adequate for gravity-drained sediment basins adjacent to a holding pond. A safety factor of 2.5 is recommended for all sites with climate similar to that of eastern Nebraska. The disposal system should include a permanent pumping station with a distribution system that can apply effluent under saturated soil conditions. The system should not be designed to irrigate cropland unless irrigation is already used or planned. Manure pumps with agitators, rather than centrifugal pumps, should be used if the system uses a combination sediment basin-holding pond. (Gilbertson-USDA-SEA-AR)

**5871-A11, B1, B2
SPECIFICATIONS FOR DEALING
A ROYAL FLUSH**

North Carolina State University, Raleigh, North Carolina
B. Driggers and J.C. Barker
Hog Farm Management, V. 15, No. 10, p. 76, 80, 1979. 2 tab.

Keywords: Flushing, Swine wastes, Performance, Ventilation, Odors, Gases

Benefits of flushing swine buildings are: (1) The in-house environment and animal performance is improved by reduced pit gas and odor generation; (2) Elimination of solids buildup in pits; and (3) Reduction of highly odorous pit gas exhausts outside the building. Pit ventilation should still be provided even though the primary source of gas and odor generation has been removed by flushing. For all buildings, flushing under slats or raised decks is recommended, while open gutter flush systems are only suggested for gestation and breeding buildups. In the design of a flush system with tanks, a tank capacity of approximately two gallons of water per 100 lb. of animal weight was successful. In a tank 4-8 feet above the pit floor, a four inch diameter discharge outlet appears to adequately clean buildings less than 200 feet in length, sloped uniformly two percent, and with a gutter floor or pit width not exceeding four feet. Pit dividers are necessary to channel the flush water and prevent meandering around heavy waste concentrations. Drain pipe sizes must be large enough to handle the discharge rate into the pit or gutter for transporting the waste from the collection units to the lagoon. An eight inch drain pipe is the smallest size recommended for wastewater transport. (Little-East Central)

**5872-A2, B2, B3, D1, E2
DEBRIS BASIN CHECKS POINT POLLUTION RUNOFF**

Staff Editor, Feedlot Management
S. Aldrich
Feedlot Management, V. 20, No. 6, p. 26, June, 1979.

Keywords: Feedlot runoff, Cattle wastes, Land application, Evaporation, Debris basins, Settling

Stanley Gail of Central Nebraska maintains a 600-700 cattle feedlot. Runoff from this feedlot was working its way into Maple Creek just below the feedyard. Gail, working with the Stanton County Soil Conservation Service,

built a debris basin and dike around the lower edge of his feedyard to keep runoff out of the creek. Underground tilling in the basin allows excess waste water to filter into a sump. It is then pumped through a four-inch line that runs under Maple Creek, up the hill across from Gail's farm into a holding pond. Solids are allowed to settle in the debris basin. When the basin dried, Gail scrapes them and spreads the solids over crop ground. This project has worked very well to solve Stanley Gail's runoff problems. (Little-East Central)

5873-B3, C2, C3, D3, E2, E3, F1, F4

WASTE HEAT UTILIZATION FOR AGRICULTURE AND AQUACULTURE

Tennessee Valley Authority and Electric Power Research Institute
L.L. Behrends, E.R. Burns, J.B. Glude, K.L. Grannemann, W.A. Hubert, J.J. Maddox, C.E. Madewell, D.A. Mays, R.S. Pile, R.L. Snipes, J.M. Wyatt, and R.K. Kavaratani

Tennessee Valley Authority Bulletin Y-132, Technical Report B-25, Aug., 1978, 62 p. 10 tab., 225 ref.

Keywords: Animal wastes, Land application, Lagoons, Anaerobic, Aerobic, Fish, Refeeding, Phytoplankton, Phosphorus, Nitrogen, Volatilization, Ammonia, Economics, Anaerobic digestion, Single cell protein, Algae, Potassium, Heavy metals, Trace minerals, Macrophytes

Research of biological systems to recover nutrients from wastewater sources is expanding due to dwindling energy reserves, interest in conservation, and attempts to protect the environment. Primary emphasis has been given to those projects in the U.S. which have taken a multifacet approach addressing water quality problems, multiproduct evaluation, and the potential for waste heat application. Projects which advocated the use of livestock manures as a nutrient source for aquatic growth were given preferential treatment. Some projects that used ambient temperature and municipal wastewater sources as well as livestock wastes were reviewed. No projects were identified in the United States that used power plant cooling water and livestock manures for aquatic production. Problems associated with maintaining high-density algal cultures in temperate zones, quality control of the culture, and small profit incentive are deterrents to aquatic reclamation systems that use livestock manures or municipal wastewater with phytoplankton-bacteria communities as the basis of their food chain. The culture of aquatic organisms which feed upon the algal and bacterial community circumvents the problem of algal harvesting. Methane generation from plants produced in recycling waste-heat projects may have potential. Information is needed on the effect of waste-heat temperatures on the growth of selected aquatic macrophytes and on the use of these plants to produce methane gas. Recycling foodchains should be short for maximum nutrient and energy utilization. An in-depth economic assessment of bio-recycling at power plants is crucial to management and research decisions. (Behrends: Stiles, ed.)

5874-A2, B1, B2, C2, D3, E2, F1

FEEDLOT RUNOFF CONTROL RESEARCH PROGRAM

E.C. Dickey and D.H. Vanderholm
Illinois Institute for Environmental Quality, IIEQ Document No. 78/06, 55 p., 1978. 30 fig., 6 tab., 14 ref.

Keywords: Water pollution, Feedlot runoff, Cattle wastes, Swine wastes, Economics, Waste management, Nitrogen, Phosphorus, Potassium, Sodium, Chemical oxygen demand, Land application

In 1974, six commercial livestock operations in northern and central Illinois helped to evaluate installed feedlot runoff control systems in terms of their management requirements, operator acceptability, and their overall effectiveness in preventing water pollution. The systems monitored were controlling runoff from beef, dairy, and swine operations. The conventional system is used by most states. This system consists of facilities for clean water diversion where necessary, a collection channel, settling basin, runoff holding pond, and pumping equipment for dewatering the holding pond. Excessive labor was not required by the farmer in cleaning the settling basin and dewatering the holding pond. All of the systems studied effectively prevented feedlot runoff from polluting streams and rivers. They also provided effective, practical, and relatively economical means of controlling feedlot runoff in almost every farm situation. (Little-East Central)

5875-A11, B3, E3

STUDIES INVESTIGATING POSSIBILITIES OF UTILIZING DECANTED SOLIDS FROM PIG FAECES IN THE NUTRITION OF FATTENING CATTLE. II. COMPARISON OF DIFFERENT TYPES OF RATIONS

G. Flachowsky
Archiv für Tierernährung, Bd 27, 1977, H. 1, p. 57-60. 2 fig., 7 tab., 34 ref.

Keywords: Swine wastes-decanted, Cattle, Refeeding, Performance

A 315-day feeding trial (F 3) was carried out with fattening bulls (starting weight: ≈ 125 kg per animal) during which four groups of seven bulls each were fed four mixtures of pelleted food: (1) concentrates, (2) concentrates + 50% straw meal, (3) concentrates + 25% straw meal and 25% decanted solids from pig faeces, (4) concentrates + 50% decanted solids from pig faeces. The bulls in group 1 and 4 received one kg of meadow hay per day in addition to the pellets. Within the framework of a calf-raising trial the animals had already received pellets containing straw and other solids. The average daily weight increases of the bulls in these four groups were 1032 g, 1052 g, 1040 g and 844 g per animal/day. The energy intake per g weight increase was 3.36, 3.07, 3.11 and 3.85 kEfr units; the requirements for food concentrates amounted to 4.60, 3.23, 3.23 and 3.47 kg of dry matter per kg of weight increase. The reasons presumed to account for the unfavourable results in group four are discussed in some detail. A further trial (F 4) was performed with a group of 20 bulls for a period of 252 days to test the results obtained with ration three. Depending on the liveweights of the animals the bulls were fed rations containing 20%, 25%, or 30% of straw meal and solids from pig faeces. For the entire period of the trial the daily weight increases were 1041 g per animal; the energy intake per

kg weight gain was 4.05 kEfr units and 4.03 kg of dry matter of concentrate were necessary to produce one kg of weight increase. The results obtained in the two trials indicate that solids from pig faeces may be used, in limited quantities, as food component in the feeding of fattening cattle. (Flachowsky)

5876-A11, B3, E3

STUDIES ON MALE SHEEP INVESTIGATING THE FEEDING VALUE OF EXCRETA FROM YOUNG HENS AND BROILERS

A. Hennig, H. Jeroch, H.H. Lohnert, and G. Flachowsky
Archiv für Tierernährung, Band 25, Heft 8, 1978, p. 583-586. 3 tab., 17 ref.

Keywords: Digestibility, Sheep, Poultry wastes, Poultry litter, Diets, Performance, Refeeding

Five digestibility trials were carried out, each with four male sheep, to investigate the excreta of young hens and broilers produced as litter in hen batteries for rearing and fattening stock. Data on the digestibility of organic matter and energy of broiler excreta were 76.0% and 76.4%; i.e. these values were only slightly lower than those for the basal ration (barley - dried green lucerne: 76.6% and 76.8%). Digestibility co-efficients for organic matter and energy content in the excreta of young hens were 69.4% and 70.4% respectively. The protein digestibility of excreta of broilers and young hens was 82.3% and 84.3%; that is to say, the investigated droppings contained 330 g and 260 g of digestible crude protein per kg of dry matter. Due to the high ash content of the samples the energy content of the analyzed excreta was only 474 Efr and 421 Efr per kg of dry matter. (Hennig)

5877-A11, B3, E3

STUDIES INVESTIGATING POSSIBILITIES OF UTILIZING DECANTED SOLIDS FROM PIG FAECES IN THE NUTRITION OF FATTENING CATTLE

G. Flachowsky, C. Geissler, and H.J. Lohnert
Archiv für Tierernährung, Heft 3, Band 27, 1977, p. 225-233. 6 tab., 24 ref.

Keywords: Swine wastes-decanted, Cattle, Acetate, Propionate, Butyrate, Diets, Refeeding, Performance

Three feeding trials were carried out in which dried and decanted solids from pig faeces were used in varying proportions. A total of 55 fattening bulls were slaughtered at the end of the trial period. Additionally, a number of characteristic data on ruminal physiology were determined in these trials. The molar proportions of acetate and propionate found with the feeding of rations containing faecal solids were intermediate between those observed in concentrate feeding and those established with the feeding of commercial food pellets containing 40% or 50% straw. Slight increases in the molar proportion of butyrate were noticed when rations were fed containing faecal solids. Nonfasted animals

fed rations containing a higher proportion of coarse fodder had a significantly lower slaughtered body mass (0:50% straw, 25% straw - 25% faecal solids; 50% faecal solids; 55.7%; 51.9%; 51.1%; or 52.2% of the final fattening weight). They developed a lower proportion of flesh and contained a higher proportion of digesta in the stomach and intestines (11.4%; 18.4%; 17.0%; or 16.3% of the final fattening weight). The proportion of fat contained in the stomach and bowels decreased with the feeding of straw or faecal solids. Other organs and tissues were not affected by the different types of feeding used. An analysis of the results of slaughtering showed that the feeding of faecal solids did not produce any specific effect. (Flachowsky)

5878-A2, A8, B1, C3, D3, E2, E3, F3
RESEARCH NEEDS ASSESSMENT-LIVESTOCK MANURE MANAGEMENT IN THE UNITED STATES

The Ohio Agricultural Research and Development Center, Wooster, Ohio 44691
 R.K. White
 Environmental Protection Agency, EPA-600/2-79-197, August, 1979, 52 p. 18 ref.

Keywords: Animal wastes, Waste management, Waste disposal, Land application, Odors, Feedlot runoff, Refeeding, Anaerobic digestion, Toxicity, Fertilizers

The purpose of this report is to identify and assess research needs for livestock manure management as related to environmental quality. Needs identified are prioritized and assigned to one or more function areas, such as, environmental quality, demonstration, livestock production, education, and energy. (White-Ohio Agricultural Research and Development Center)

5879-B3, B4, D2, D3, E3, F1
NUTRITIONAL ASPECTS OF REFEEDING CATTLE MANURE TO RUMINANTS

Department of Animal Science, North Carolina State University, Raleigh, North Carolina 27650
 W.L. Johnson
 Journal Agricultural Food Chemistry, V. 27, No. 4, p. 690-694, 1979. 6 tab., 32 ref.

Keywords: Refeeding, Cattle wastes, Waste disposal, Economics, Feedlot wastes, Fermentation, Anaerobic, Waste storage, Digestibility, Palatability

Cattle excrete manure dry matter at a daily rate of about 1% of body weight. In intensive confinement management systems proper manure disposal may be a major cost item; recovery of residual utility is therefore desirable if it can be done economically. Evidence that cattle manure does have residual nutritional value and that refeeding can be safe and economical is reviewed in this paper. Factors which influence the energy and protein value of manure or its derived products are discussed, including the influ-

ence of the ration originally fed to animals from which manure is collected and the type of processing which the manure may undergo. Other considerations for the formulation of rations with manure or manure products are palatability, the nutrient requirements of the recipient animals, disease and parasite transmission, presence of undesirable residues, performance of recipient animals, quality and consumer acceptance of the meat or milk produced, the cost of recycled nutrients compared to conventional feed sources, and the legal status of manure-derived feedstuffs. (Johnson-North Carolina State University)

5880-A1, A4, A6, B2, B3, C2, E2
MANURE MANAGEMENT

D. Strauch
 World Health, Oct., 1978, p. 18-21.

Keywords: Waste management, Land application, Animal wastes, Waste disposal, Temperature, Pathogens, Salmonella, Phosphates, Nitrates, Nitrogen, Copper, Zinc, Iodine, Sulphur, Iron, Manganese

By-products of animal production that pose an indirect threat to human health consist of the daily excrement of the animals in the form of dung and urine, whether mixed with straw as solid manure in the animal pens, or as solid or liquid manure in other animal enclosures. Conventional methods of disposing of animal wastes are proving inadequate in many countries since the actual numbers and density of animal populations have increased in rural areas and in towns. The most common method of disposing of animal faecal waste is to spread it on the land as manure. The sanitary problems involved with this type of disposal must be considered from two aspects: (1) the epidemiology of infectious diseases, and (2) the general principles of animal husbandry. Most infected animals eliminate pathogenic agents by way of the faeces or urine. Therefore, the land disposal of infected animal wastes can result in the transmission of pathogenic micro-organisms to man. It is essential to prevent spreading of germs by on-site treatment. Solid manure is composed in dung heaps which develop such high temperatures that pathogens were destroyed. However, in liquid manure this does not occur. Salmonellas may survive for long periods in faeces, slurry, sewage, soils and on plants, so these must be disinfected prior to agricultural use by chemical or physical-biological methods. Dung surplus enterprises have grown-up in cattle-rearing areas, where the agriculturally useful area is no longer enough to absorb all the dung that is produced. For example, in north-western areas of the Federal Republic of Germany a concentration of 94 milligrams of nitrates per litre of water has been determined in the water-table beneath land that is heavily polluted with liquid manure. This is twice the maximum value recommended by WHO to avoid methemoglobinemia in infants. Precautions should be taken with manure when copper and/or zinc are added to the animals' feedstuff. Intensive livestock units should be managed with great care and precision, and with methods which directly and indirectly protect human health and animal health if the enterprise is to succeed. (Stille-East Central)

5881-B1, B3, B4, C1, D1, E2, E3, F1
THE HIGH-RISE SYSTEM OF MANURE MANAGEMENT

Department of Agricultural Engineering, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, New York 14853
 A.T. Sobel
 Final Report, ARS-USDA Cooperative Agreement, No. 12-14-100-11, 344(42), March, 1976, 45 p. 24 fig., 21 tab.

Keywords: Waste management, High-rise, Solid waste management, Waste storage, Temperature, Economics, Odor control, Recycling, Design, Moisture content, Land application

The high-rise system of manure management is a solids handling system that presents many desirable aspects of a manure handling system such as storage, low cost, reduction in weight, and odor control. The information obtained from a three year study at a high-rise laying house is presented to provide an insight into the complexities of such a system. Measurements of temperature indicated a temperature rise within the accumulated manure which provided a driving force for the removal of moisture. The accumulation of manure was in a series of ridges and valleys with the build up being linear with time. The air velocity distribution within the storage area determined the magnitude of drying at individual locations. The average velocity determined the average or system moisture content. Labor requirements during cleanout indicated the high-rise manure management system had the lowest requirement compared with other systems. The stored manure was available as a nutrient source which was recycled through a corn crop. A theoretical analysis of the various parameters influencing the drying of the manure in the high-rise house established a prediction equation for the resulting moisture content of the stored manure. System design information based on the house studied was determined. Present trends in increasing the bird density present difficulties in managing the high-rise system. (Sobel-New York State College of Agriculture and Life Science)

5882-A8, E2
EFFECT OF FARMYARD MANURE AND WHEAT STRAW ON THE RESPONSE OF MAIZE TO ZINC IN A ZINC-DEFICIENT SOIL

Haryana Agricultural University, Hissar 125 004
 U.C. Shukla, H. Raj, and K. Singh
 Indian Journal of Agricultural Science, V. 48, No. 8, p. 483-486, August, 1978. 2 tab., 8 ref.

Keywords: Animal wastes, Zinc, Soils, Crop residues, pH, Soil properties, Moisture content, Crop response, Land application

In a greenhouse experiment conducted in a Zn-deficient loamy-sand soil, the dry-matter yield of maize (*Zea mays* Linn) increased considerably with the application of Zn. There were no differences among different levels of Zn, and Zn concentration and uptake increased with an increase in the level of Zn. Without a supplemental application of Zn, application of farmyard manure increased the dry-matter yield, Zn concentration and Zn uptake, whereas when applied along with Zn there was a significant decrease in yield, Zn response and Zn uptake, particularly with the application of 20 tonnes farmyard manure/ha, compared with the application of Zn only. The effect of wheat straw on dry-matter yield, Zn

response and Zn uptake was generally similar to that of farmyard manure, but was of less magnitude. (Shukla-Haryana Agricultural University)

5883-B2, B3, C3, D1 TREATMENT OF PIG SLURRY USING A BIOLOGICAL FILTRATION TOWER

Terrington Experimental Husbandry Farm
E.J. Mundy and D.A. Joyce
Experimental Husbandry, No. 34, p. 130-138,
1978. 2 fig., 3 tab., 5 ref.

Keywords: Swine wastes, Waste treatment, Filtration, Anaerobic, Aerobic, Waste disposal, Effluent, Odor, Copper, Zinc, Phosphorus, Nitrogen, Potassium, Moisture content

A system of aerobic treatment, making use of a high rate biological treatment tower, was tested at Terrington Experimental Husbandry Farm between April, 1973 and September, 1976. Slurry from a 240-pig fattening house was treated by the high rate filtration tower under test. The treatment process is considered in three stages: (1) Mechanical separation of coarse solids, (2) Biological aerobic treatment in the tower, (3) Separation and disposal of secondary sludge and treated effluent. Mechanical separation using a prototype moving belt press separator removed coarse solids with a dry matter content of approximately 30 percent representing 15 to 25 percent of total solids. In the tower, BOD₅ and total solid losses represented 59 percent and 25 percent respectively of the estimated total input. Odor was largely eliminated. Separated liquid sludge accounted for 62 percent of the liquid input and presented a disposal problem of similar magnitude as the untreated waste. (Little-East Central)

5884-A2, A6, E2, E3, F1 TCFA SURVEY EFFICIENCIES AND DEFICIENCIES SHOW UP AMONG TEXAS LOTS

Southwest Editor, *Calif News*
J. Sinise
Calif News, V. 17, No. 10, P. 10, 12, Oct.,
1979.

Keywords: Economics, Feedlot runoff, Feedlot wastes, Nitrogen, Phosphorus, Anhydrous ammonia, Waste management, Land application, Dust, Odors, Flies, Refeeding

An environmental and energy survey of feedlots was conducted by the Texas Cattle Feeders Association (TCFA) in cooperation with the Texas Agricultural Extension Service (TAES). Directing the survey were Dr. John Sweeten, extension Agricultural engineer, TAES, and Dr. Richard P. McDonald, TCFA. Questions included those on Runoff Control System; Solid Waste Management Systems; Land Disposal; Dust, Odor and Fly Control; Manure Processing and Utilization; Water Supply System; Feed Distribution System; and Feed Processing System. The researchers summarized the results by saying that despite the fact that feed yards have installed adequate water pollution control systems, general improvements could be made in maintaining them. They stated that the price

availability and apparent demand for manure varied enormously among the feed yards surveyed. Most of the lots believe fuel gas production would be the most beneficial use of manure. In contrast, refeeding manure is held in low regard by most feed yards. The major obstacles to feeding animal manure were costs and mechanical systems for processing and handling. The survey showed that over one-half of the feedlots indicated that feedlot dust is an annual problem, while 20% perceive dust problems periodically and only 26% felt dust is never a problem. The most frequently used method of odor control is "good drainage" which also received the highest effectiveness rating. According to McDonald, feedlots appear to generally be knowledgeable about fly and odor control practices that are currently available. (Stiles-East Central)

5885-B2, C1, C2, D1, F1 A FARM PLANT FOR PIG SLURRY TREATMENT

Livestock Department, Farm Buildings Division, N.I.A.E., Silsoe, Bedford, England
L.E. Osborne and E.J. Mundy
Journal of Agricultural Engineering Research, V. 22, p. 405-420, 1977. 12 tab., 9 ref.

Keywords: Swine wastes, Slurries, Separation, High-rate filtration, Dewatering, Effluent, Phosphorus, Potassium, Equipment-separator, Settling, Sampling, Evaporation, Biochemical oxygen demand, pH, Copper, Zinc, Nitrogen, Economics, Waste treatment

The slurry from about 200 fattening pigs was treated over a period of 56 weeks in a treatment system with separation, high-rate filtration and sludge de-watering stages. The over-all output of the system consisted of separated solids (19% of slurry input) and de-watered sludge (52% of slurry input) which were stored on the farm midden and were relatively smell-free and easy to handle. When evaporative losses were low in winter there was some filtrate from the de-watering stage for disposal as liquid effluent. When evaporative losses were high in summer water was added to maintain the plant liquid level. A total of 28,950 l of water were added and 25,190 l of filtrate removal giving a net 3760 l water input in addition to an estimated 20,160 l of rainwater which entered the plant. If rainwater were excluded it is likely that there would be no liquid effluent from the plant even when evaporative losses were lower than those prevailing during the trial period which included the hot dry summer of 1975. There was good agreement between the evaporative losses calculated from the experimental results and those predicted from weather data. About 38% of total N and 77% of NH₄-N were lost during treatment but there was no loss of P and K. The sludge was conditioned prior to de-watering with aluminum chlorohydrate or ferric sulphate which was the cheaper at £ 2.64 pig place per year. Laboratory trials showed that a number of polyelectrolytes were ineffective and none was as cheap as ferric sulphate. The complete system was easily operated by farm staff, and apart from the separator, which was a very early prototype machine, was robust and reliable enough for farm conditions. (Osborne-Farm Buildings Division)

5886-A11, C2, D1, E2 EFFECT OF CONTINUOUS FEED-

ING THE SUN DRIED CHICKEN MANURE ON THE PERFORM- ANCE OF THE THIRD GENER- ATION LEGHORN FEMALE CHI- CKS

Taiwan Livestock Research Institute, Hainan, Tainan, Taiwan, Republic of China
P.K. Lee
Journal of the Agricultural Association of China (Taiwan), No. 104, p. 66-74, Dec., 1978. 5 tab., 22 ref.

Keywords: Refeeding, Poultry wastes, Performance, Poultry, Diets, Dehydration

Study was made to determine the effects of continuous feeding of the sun dried chicken manure containing dry matter 89%, crude protein 16.7%, crude fat 5.21%, crude fiber performance of the third generation Leghorn female chicks. A total of 186 third generation day old female chicks, 184 pullets, 180 layers were used. The results were given in tables 2 to 6 respectively. It indicated that the mean value of weight gains and feed conversion rate at 18 weeks of age, pullet age and weight at the first egg, weight of the first egg, egg production, feed required to produce one dozen or one kg. of eggs during 6 months of the trial, percentage weight of egg shell, yolk, thick white and thin white, egg fertility, hatchability to hatching eggs or ratio hatchability to fertilized eggs for the basal control diet were 1358.6 gm, 5.289, 139.32 day, 1450.59 gm, 35.91 gm, 77.79%, 1445.66 gm, 2268.78 gm, 11.89%, 28.09%, 29.75%, 30.27%, 93.85%, 77.09%, 82.14% while the diet containing 15% sun dried chicken manure were 1274.85 gm, 5.597, 142.34 day, 1467.50 gm, 36.92 gm, 78.30%, 1540.35 gm, 2421.32 gm, 12.18%, 27.89%, 29.63%, 30.30%, 96.10%, 80.05%, 83.29%. The analysis of variance of the above said performance determinations between the two experimental diets all showed no significant differences. The chicks fed on diet containing the sun dried chicken manure were healthy and vigorous. No detrimental effects were observed on the health of the chicks throughout three generations of the study. From the above data we found that the sun dried chicken manure which contained dry matter 89% and crude protein 16.7% could continually be used as substitute for 15% equal weight of feed ingredient in diet. There were no ill effects on the performance of the third generation Leghorn female chicks. (Lee-Taiwan Livestock Research Institute)

5887-A11, B3, C2, D2 EVALUATION OF DRIED RABBIT MANURE AS A FEED FOR RABBITS

Department of Animal Science, Oregon State University, Corvallis, Oregon 97331
R.A. Swick, P.R. Chedde, and N.M. Patton
Canadian Journal of Animal Science, V. 58, p. 753-757, Dec., 1978. 4 tab., 13 ref.

Keywords: Rabbit wastes, Refeeding, Rabbits, Diets, Autoclaving, Digestibility, Alkali, Recycling, Performance, Crude Protein

The digestibility of dried rabbit manure when fed to rabbits was examined. Diets contained 75% manure; treatments included alkali (2% w/w NaOH) treatment, autoclaving, and alkali treatment plus autoclaving. All treatments increased (P<0.01) digestibility of crude protein, cell wall constituents (CWC)

and acid detergent fiber (ADF) as compared to untreated manure. Digestibilities for untreated, alkali-treated, autoclaved, and alkali-treated-autoclaved manure, respectively, were: ADF: 8.1, 39.4, 16.8, 35.8; CWC: 16.0, 41.7, 23.9, 36.1; crude protein: 36.7, 50.4, 50.6, 45.0. Digestible energy for untreated manure was 772 kcal/kg, and 1,970 kcal/kg for alkali-treated manure. Untreated and alkali-treated manure samples were compared to feces and alfalfa hay by the *in vitro* bovine rumen fermentation technique. Dry matter digestibilities were 18.3, 24.4, 34.7 and 43.1% for untreated manure, alkali-treated manure, feces hay and alfalfa hay, respectively. A growth and mortality study using 40 weanling New Zealand White rabbits was conducted. A low fiber, high energy basal diet was used, and the effects of addition of 10% alfalfa meal, 10% rabbit manure, or 10% alkali-treated manure were determined. There were no differences ($P < 0.05$) in growth rate; mortality from enteritis was 30% for the low fiber diet, and 0% with the diet containing untreated manure. (Swick-Oregon State University)

5888-B2, B3, C2, D3, E3, F4 METHODS OF BIOLOGICAL RECYCLING OF NUTRIENTS FROM LIVESTOCK WASTES: A LITERATURE REVIEW AND SYSTEMS ANALYSIS

Tennessee Valley Authority, Muscle Shoals, Alabama
R.A. Stanley
Bulletin Y-80, Natural Fertilizer Development Center, Tennessee Valley Authority, 1974, 45 p.

Keywords: Recycling, Livestock wastes, Animal wastes, Fish, Duckweed, Algae, Phytoplankton, Adsorption, Fiefeeding, Land application, Ammonium, Phosphate, pH

Livestock produce considerable quantities of solid and liquid wastes, which are relatively high in essential inorganic nutrients. The shortage of compounds containing these essential nutrients limits natural productivity on agricultural land and in aquatic sites. Therefore, these animal wastes are potentially a valuable resource that might be used to increase productivity of desirable and readily harvestable products from land and water sites. One possible, practical application is the enrichment of ponds for increased productivity of fish or clams. The major problems in the development of a biological nutrient-recycling system include dealing with low oxygen concentrations, achieving balance among various components, maximizing productivity, and minimizing the area and the volume necessary to recycle a maximum quantity of animal wastes. Duckweed-to-white amur, phytoplankton-to-silver amur, and phytoplankton-to-clam systems are considered in as much detail as available data allow. The phytoplankton-to-clam system seems to have the best potential for obtaining the maximum usable yield per unit space per unit time, but other systems should be tested. (Stanley-Tennessee Valley Authority)

5889-B3, B4, C1, C2, D1, D2, E2, E3, F1 SYNTHESIS GAS FROM FEED-

LOT MANURE CONCEPTUAL DESIGN STUDY AND ECONOMIC ANALYSIS

Department of Chemical Engineering, Kansas State University, Manhattan, Kansas 66506
C.R. Engler, W.P. Walawender, and L. Fan
Environmental Science and Technology, V. 13, No. 9, p. 1152-1157, 1975. 4 fig., 3 tab., 16 ref.

Keywords: Gas, Feedlot wastes, Design, Economics, Waste disposal, Pyrolysis, Ammonia, Carbon Hydrogen, Oxygen, Nitrogen, Sulfur, Ash, Gasification, Dehydration, Waste storage, Moisture content

A conceptual process design for the pyrolysis of feedlot residues was employed as a basis for economic evaluation of the concept of pyrolysis as a disposal alternative. Sensitivity analysis with respect to plant size, residue moisture content, transportation costs, and other factors were conducted. The results indicate that only large-scale processing under the most favorable conditions will approach the point of economic competitiveness. The processing scales required are compatible with high-density cattle feeding regions and end uses of the product gas. (Engler-Kansas State University)

5890-A11, B1, C3, D3, E2 EQUINE INTERNAL PARASITISM CONTROLS AND TREATMENT GIVEN

Department of Animal Science, Pennsylvania State University, University Park, Pennsylvania
C. Wolfgang and H. Rothenbacher
Science in Agriculture, V. 25, No. 2, p. 7, Winter, 1978.

Keywords: Horses, Parasites, Bloodworms, Large round worms, Tapeworms, Composting, Land application, Drugs, Management

A survey of the extent of parasitism in horses in Center County, Pennsylvania indicated the prevalent types of internal parasites and degree of infection. Knowledge of both of these factors is essential for effective treatment and control programs. Bloodworms, large roundworms, and tapeworms were found. The concentrations of these parasites varied over a range of 0 to 3,335 eggs per gram of feces. The average degree of infection among all adult working horses was 709 eggs per gram of feces. Recommended management practices for reduction of exposure of horses to infective parasites include: (1) Clean stalls daily if possible. (2) Spread manure on cropland or other ungrazed areas whenever possible. (3) Compost manure before spreading on grazed pastures. (4) Mow pasture in the spring and summer to control vegetation height. (5) Chain-harrow pasture to spread manure piles. (6) Rotate pastures between other livestock as often as practical. (7) Avoid overstocking pastures. (8) Don't feed on the ground. Provide sanitary feed boxes and hay racks. (9) Prevent manure contamination of the water supply. (10) Once a year, clean out and disinfect the entire stall and replace the top two inches of tamped clay floors. Disinfect before introducing new stock. After following these recommendations, treatment of parasitic infections becomes much easier. A fecal examination prior to worming helps the veterinarian to prescribe drugs for the best control of the parasites involved. However,

medication against parasites is not successful unless it is coupled with parasite control through competent management. (Merriman-East Central)

5891-A11, B1, B3, B4, C1, C2, D1, D2, D3, E3, F1 PROCESSING CATTLE WASTE FOR RECYCLING AS ANIMAL FEED

Department of Animal Sciences, Colorado State University, Fort Collins, Colorado 80523
G.M. Ward and T. Muscato
World Animal Review, V. 20, p. 31-35, 1976. 2 tab., 29 ref.

Keywords: Economics, Animal wastes, Cattle wastes-dried, Recycling, Potassium, Phosphorus, Calcium, Sodium, Lead, Cadmium, Crude protein, Pathogens, Nitrogen, Digestibility, Composting, Temperature, Wastelage, Formaldehyde, Ensilage, Dehydration

The feeding value of cattle wastes is discussed in this article in relation to alternative methods of handling and processing waste as animal feed. Research studies have shown that cattle waste will be eaten in large quantities by cattle and sheep, and that it contains nutrients that can be utilized. The most valuable nutrient is protein. The feeding trials reviewed in this article show the wide variation encountered in the nutritive value of cattle manure. Reasons for this wide variation are: (1) differences in the ration fed, (2) the surface from which the manure was collected, and (3) storage or drying conditions. Manure from cattle fed a high forage ration generally has a low feed value. Fresh manure has a higher feed value than dried manure but it cannot be mixed directly in rations. However, it can be ensiled with other feeds if an adequate collection system and silos are available. Feeding trials with fresh or dried cattle manure and manure products have not resulted in any evident disease or pathological conditions. However, the practice is not widely approved by regulatory agencies. There have been no differences detected in the quality of meat from animals fed waste nor any problems of consumer acceptance in cases where it was studied. (Stiles-East Central)

5892-A11, B3, C1, C2, D3, E3 FEEDING CORN SILAGE PLUS MANURE FROM CAGED LAYERS OR DAIRY COWS AS TOTAL MIXED RATIONS FOR DAIRY HEIFERS

Department of Animal Science, Cornell University, Ithaca, New York
J. Kall and W.G. Merrill
Proceedings, Cornell Nutritional Conference, Cornell University, 1975, p. 69-78. 2 fig., 4 tab., 13 ref.

Keywords: Refeeding, Poultry wastes, Cattle, Ensilage, pH, Moisture content, Mixing, Waste composition, Crude protein, Calcium, Phosphorus, Performance

Corn silage was mixed easily and effectively with poultry manure (caged layer droppings either wet, dry or "in-between") or with wet cow manure (from high producing, well-fed

Waste composition, Phosphorus, Potassium, Manganese, Iron, Zinc, Economics

Over 185 million broilers, averaging 3.9 pounds each, returned nearly 107 million dollars to the growers in Maryland. Approximately 250,000 tons of pure poultry manure are produced each year from broilers alone. This poultry waste is a fertilizer material of very high plant food value and of sufficient quantity to fertilize 50 to 100 acres or more of most crops. The pure poultry manure (dry basis) may contain an average of 4 percent nitrogen (N), 2½ percent phosphate (P_2O_5), and 2 percent potash (K_2O). The fresh pure manure (75% moisture) would have a plant food value of about \$4.75 per ton. The moisture content of pure fresh poultry manure varies greatly. Poultry manure available for use on farms is usually mixed with litter. Litter samples collected from Eastern Shore broiler houses from 1969 to 1971, showed the plant food value of this broiler house litter to be approximately \$21.70 per ton. Litter used for two or more broods of broilers was found to be somewhat more valuable than that used only once. Broiler house litter can also be an important source of essential secondary and micro-nutrients. An acceptable product for many home owners and florists is a mixture of poultry manure and litter such as wood shavings or sawdust if properly treated. The strong odor of ammonia in poultry houses is evidence that nitrogen is rapidly being lost from the manure. The ammonia may be lost in the atmosphere unless it is absorbed by or reacts chemically with some material. Since poultry manure contains considerable nitrogen that becomes available to the field crops throughout the growing season, excellent results can be expected from its use. In Maryland, poultry manure can be used effectively in vegetable production. Poultry manure should be applied to orchards only in late winter or early spring to prevent excessive fall growth and winter injury. (Little-East Central)

5898-A11, B1, C1, D1, E3 DRIED POULTRY MANURE IN BROILER RATIONS

Associate Professor, Department of Animal Science, University of the Philippines at Los Banos, College of Agriculture, College, Laguna
P.L. Lopez, C.C. Magbanua, and M.A. Chavez
Philippine Journal of Veterinary Animal Sciences, V. 2, p. 74-83, 1976.

Keywords: Poultry wastes-dried, Nitrogen, Diets, Phosphorus, Performance, Urea, Amino acids, Blood urea nitrogen, Poultry, Dehydration, Calcium

Differences in the results of earlier investigators and an interest to search for feed substitutes particularly from waste products were the reasons for reinvestigation of dried poultry manure in broiler rations. Two hundred and ninety-seven straight-run day-old broiler chicks of the same strain were randomly distributed to nine dietary treatments. Each treatment had three replicates with nine birds per copy. The three basal diets were to contain 17.59% comparative performance (CP) which satisfied 94-100% of the essential amino acid (e.a.a.) requirements for broilers; 15.83% CP which satisfied 84.90% of the e.a.a. requirements and 14.03% CP which satisfied 74-80% of the e.a.a. requirements.

To each basal diet, 0.76% urea was added to provide 2% CP and three levels of sun-dried poultry manure (4, 16, and 29%) to raise the CP to approximately 20%. All diets were maintained approximately at 2800 kcal ME/kg feed by adding energy sources such as wheat, flour, molasses and vegetable oil. The difference in body weights among the 11 dietary treatments were not statistically significant. Body weight gain increased slightly as the amino acid levels were increased. The mean total feed consumption (FC) at eight weeks varied from 306 g for birds receiving 4% dried poultry manure (DPM) in the diet and which satisfied 74-100% of the amino acid requirements to 3616 g for birds fed the commercial broiler ration. It was reported that the poultry manure had limited effect on body weight gain. Birds on commercial rations were significantly the poorest converter of feeds into body tissues. Birds fed the basal diet without DPM added and those receiving the three basal diets containing 4% DPM were among the most efficient in terms of feed conversion. Increasing the levels of DPM in the diet depressed feed conversion, however statistical significance was only observed between the 4% and 29% DPM. The different amino acid levels in the diet did not seem to affect feed conversion efficiency. Values for blood urea nitrogen increased with decreasing level of the e.a.a. in the diet. Similarly, blood urea nitrogen values increased with decreasing levels of DPM added in the diet. However, the difference in blood urea nitrogen was statistically significant only for DPM but not with the amino acid levels. A significantly high blood urea nitrogen value may suggest amino acid imbalance. (Stiles-East Central)

5899-A11, D2, E3 RECYCLING ANIMAL WASTES PART 2: FEEDING RECYCLED WASTES TO POULTRY AND LIVE STOCK

Agricultural Research Council Poultry Research Center, West Mains Road, Edinburgh EH9 3JS, Scotland
R. Blair and D.W. Knight
Feedstuffs, V. 45, No. 12, p. 31-35, 1973. 3 fig., 2 tab., 59 ref.

Keywords: Refeeding, Poultry wastes-dried, Recycling, Nitrogen, Poultry, Cattle, Sheep, Swine, Performance

A large number of experiments indicate that manure can be included successfully in poultry diets. It is utilized less successfully by non-ruminants. Dried poultry manure seems the most suitable of the manures from farm animals for feeding purposes, because of its higher content of nitrogen and minerals. In the United Kingdom, drying plants have been installed in a considerable number of units to dry poultry manure, and to a lesser extent poultry litter. A number of feed companies are incorporating dried poultry manure in compounded feeds, although the practice is rarely admitted openly. Some producers who have installed their own driers also incorporate dried manure in the feed used on their own units. The total amounts utilized in this way are 3-7% of the poultry manure and about 1-3% of the poultry litter nationally available, although these levels are rising quickly due to the current very high costs of protein feedstuffs. A large proportion of poultry manure could be disposed of by refeeding to ruminants. (Little-East Central)

5900-B1 PERFORATED FLOORS FOR PIG HOUSING

Scottish Farm Buildings Investigation Unit
A.M. Robertson and A.W.F. Anderson
Farm Building Progress, V. 57, p. 9-12, July, 1979. 4 tab., 5 ref.

Keywords: Floors, Farrowing pens, Swine, Slats

Manufacturers are trying to find a material suitable for use in farrowing pens catering to the new-born piglet. The performance specification of floors for pigs are: (1) Floors should not cause injury to livestock. (2) Floors should not contribute to ill-health by harbouring bacteria and parasites. (3) Floors should not contribute to "stress" or discomfort which might manifest itself in depressed growth, poor feed conversion or abnormal behavior. (4) Floor materials and structures should not deteriorate or deform during the planned life, nor should the material require maintenance during this period. (5) Floors should comply with the above requirements at the lowest cost. (6) Perforated floors should not retain faeces or urine for periods of time which necessitate some form of cleaning or scraping. For installation in dry-sow stalls and in growing-finishing accommodation for pigs of over 15-20 kg live weight, concrete slats are satisfactory. Currently being studied is the use of tri-form concrete slats in farrowing pens. Meshes are satisfactory if they are properly supported in the use of farrowing accommodation and in flat-deck accommodation for weaners. Only expanded metal causes foot and leg problems in piglets from birth until 14 days of age. Plastic materials are unsatisfactory for the sow in farrowing crates where difficulty in gaining an adequate foot hold is experienced. Unflattened plastic-coated expanded metal may be an exception and is still undergoing study. (Little-East Central)

5901-A11, C2, E3 DRIED POULTRY MANURE USED AS SHEEP RATION PROTEIN SUPPLEMENT

Anonymous
Feedstuffs, V. 46, No. 9, p. 32, March, 1974.

Keywords: Refeeding, Nitrogen, Poultry wastes-dried, Sheep, Digestibility, Diets, Ammonia, Crude protein

L.W. Smith, research animal scientist at the U.S. Department of Agriculture's Agricultural Research Service, Beltsville, Maryland, presented a paper at the Sheep Industry Development Program, Denver, Colorado, which dealt with dehydrated poultry excreta as a crude protein supplement for growing sheep. In his research, Smith found that rations supplemented with dehydrated poultry excreta (DPE) were eaten by sheep as readily as rations supplemented with soybean meal. In Trial 1, DPE-nitrogen was substituted for soybean meal at levels of 0, 50, and 100% in rations 1, 2, and 3 respectively in a complete pelleted ration. Six wethers were fed the three rations as needed in two 3x3 Latin square digestion experiments balanced for carryover effects. Feed intakes, feces and urine outputs were measured during the last five days of three consecutive 15-day feeding periods. In Trial 2, eight sheep were fed rations of 19, 38, or 100% DPE. Two sheep were fed for each ration. Total feces and urine

dairy cows) when evaluated at levels up to 16% of the ration dry matter and fed as nutritionally balanced, total mixed rations for yearling dairy heifers. Corn silage plus poultry manure (any moisture level and seemingly any "condition" of "quality") was readily consumed by yearling dairy heifers at dry matter intakes about 10-15% higher than that for corn silage alone, equal to that for corn silage alone, equal to that for corn silage plus chopped alfalfa hay, and only 5-10% lower than for a "high quality" ration combination of corn silage, hay-crop silage and grain. Corn silage plus fresh cow manure, mixed one or more days before feeding was consumed at levels equal to that for corn silage alone (30 to 40% DM content), or at about 15% higher dry matter intakes when using corn silage containing less than 30% DM content. Poultry manure effectively supplemented corn silage with needed nitrogen and minerals for feeding earling dairy heifers. The energy dilution from the addition of poultry manure was no practical limitation to meeting the energy needs of yearling dairy heifers. Dry matter intake was increased about 15% over corn silage alone and body weight gains were increased. Mixing 15% (dry basis) of fresh cow manure with corn silage one day before feeding still maintained a pH below 4.5. This has been shown to be effective in destroying most common organisms when manure was mixed before ensiling (10). Whether similar results occur when manure is mixed with silage after ensiling, needs to be determined directly. (Kall-Cornell University)

5893-A11, B1, F1 BEEF AND BUILDINGS: HE STAKES HIS NAME ON BOTH

Staff Editor, *Feedlot Management*
S. Aldrich
Feedlot Management, V. 20, No. 11, p. 52,
54-56, Nov., 1979.

Keywords: Confinement, Economics, Potato
wastes, Performance, Cattle, pH, Fermenta-
tion

Ed Hanenburg of Coopersville, Michigan stakes his name on his unique cattle business. Hanenburg, who is in a 50/50 partnership with his cousin Glenn, does the buying and selling while Glenn takes care of the day to day management. Their feedlot is a showplace because they like it neat and clean. Their confinement building is 92 x 204 feet doublewide. It is slatted on the west side for finishing cattle and solid on the east side for starting them. A feeding alley runs down the middle. Pivot doors on the west side can be opened or closed and the east side is open year round. The opening in the roof ridge is 16 inches across - about two inches for each 10 feet of building width. The 204 foot long "chimney" is formed by a ridge that sticks up 10 inches past the peak of the roof. This raised ridge draws air out of the building and helps keep rain and snow from falling in. On the east side of the building the solid floor is scraped once each week. After scraping, a big round bale of wheat straw is dropped into a tub grinder. Chopped wheat straw is blown over the cattle as the grinder is pulled along the feeding alley. The cattle need the roughage and can bed in the straw. In 1977, the barn cost \$100 per head capacity for the pit and slats; now it is up to \$180. Hanenburg thinks that an economical alternative for a cattleman who wants to expand might be cold confinement with a solid concrete scrape floor. He wants to construct another building hoping to increase one-time capacity to 2,000 head.

He is experimenting with five different rations. After 14 days, cattle should be eating everything they need to reach the goal of 2.75 lb. per day ADG. The finishing ration contains about 20% hay, 40% potato waste, 40% shell corn plus a little corn silage. (Little-East Central)

5894-B2, B3, C1, C2, C3, D1, D3, E2 METHANE GAS PRODUCTION FROM ANAEROBIC DIGESTION OF HOG MANURE IN THE MES- OPHILIC TEMPERATURE RAN- GE

University of Manitoba, Winnipeg, Manitoba
J.O. Finnie
Progress Report, Department of Civil Engi-
neering, University of Manitoba, May, 1972,
10 p. 3 fig., 3 ref.

Keywords: Methane, Anaerobic digestion,
Digesters, Swine wastes, Mesophilic, Liquid
wastes, Retention times, Volatile solids,
Ammonia, Nitrogen, Separation, pH, Temper-
ature, Mixing, Urine, Land application,
Dilution, Loading rates

The application of the anaerobic digestion process as a method of recovery of useable energy is being evaluated with laboratory digesters. At a temperature of 98°F the digesters are being operated, with once a day feeding and withdrawal, at different loading rates and retention times. Poor results were obtained from digesters operated on feed containing liquid portions of manure. One digester, being fed the separated solids portion of the manure at a loading rate of 1216 v.s./cu. ft./day, operated efficiently for a period of 30 days without showing any signs of failure. The average gas yield from this digester per lb. of volatile solids added was about 150 liters per day. Analysis of the gas showed a methane content of 50 to 60 percent. It appears that ammonia nitrogen concentrations in the urine are at a level which is toxic to the digestion process and it is necessary to separate the solids from the liquid before feeding the manure to the digester. Additional tests are now underway to establish a more definite conclusion to this theory. (Finnie-Uni-
versity of Manitoba)

5895-A6, A7, B2, C3 GASES FROM STORED SWINE WASTES

A. J. Muehling
University of Illinois, Cooperative Extension
Service Fact Sheet, 2 p.

Keywords: Swine wastes, Gases, Ammonia,
Hydrogen sulfide, Methane, Confinement,
Anaerobic

The most important gases generated from stored swine wastes are carbon dioxide, ammonia, hydrogen sulfide, methane, and a large group of trace organic compounds. Most of the gas in the bubbles coming from stored liquid manure lagoons or oxidation ditches is carbon dioxide. It is toxic to humans only in high concentrations. Concentrations of 100,000 ppm in confinement buildings cause violent panting, and higher concentrations have a narcotic effect. Death will occur after a few hours of concentrations of 250,000 ppm or more. Ammonia is released from fresh manure and during anaerobic decomposition of organic matter. The problem is less with

slatted floors than with solid floors, particularly heated ones, because of ammonia's high solubility in water. It does not burn readily, but air mixtures of over 16% ammonia are considered explosive. Because it is an irritant, ammonia tends to produce discomfort in pigs, but only in extremely high concentrations does it cause permanent damage. Prolonged exposure may make the pigs more susceptible to respiratory diseases. Hydrogen sulfide is produced from the decomposition of organic wastes under anaerobic conditions. Dangerous concentrations can be released by vigorous agitation of stored liquid manure. Methane is generated from the anaerobic decomposition of manure. It is not considered a toxic gas, but concentrations can develop that produce an asphyxiating atmosphere. However, explosions attributed to methane have occurred around manure storage pits. A confinement unit should have some type or safety or warning device to notify the operator if the mechanical ventilation system fails. (Stiles-East Central)

5896-A6, D1, F1 ODOUR ABATEMENT IN POUL- TRY MANURE DRYING

Department of Trade and Industry, Warren
Spring Laboratory, Gunnele Wood Road,
Stevenage, Hertfordshire SG1 2BX, England

T.A. Dorling and B.W.J. Lynch
4th European Poultry Conference, London, p.
503-511, 1973. 3 fig., 2 tab., 4 ref.

Keywords: Poultry wastes, Combustion,
Nitrogen, Catalysts, Odor, Gases, Temper-
ature, Economics, Dehydration, Equipment-
dryer, Design, Gas Chromatography, Am-
monia, Sulphides, Ketones

The thermal and catalytic combustion of the malodorous constituents occurring in the effluent of poultry manure dryers was studied. Also investigated was the dependence of the efficiency of the after-burner upon temperature, residence time, linear velocity, available surface and type of catalyst. Information was obtained on the types of malodorous present in the effluent from poultry manure drying. Satisfactory abatement was achieved by thermal and catalytic combustion at residence times of less than 0.1 s and mean temperatures of 600 and 350°C. The most efficient catalysts tested were commercial platinum and palladium-supported-on-ceramic honeycomb and the platinum-on-metal mesh. To obtain the required after-burner temperatures, the simplest and most convenient method is to heat the contaminated air with a natural gas or gas oil burner. By employing noble-metal catalysts the capital cost of an efficient catalytic system compares very unfavourably with the cost of the dryer and the operating costs of a thermal system should tend to make the process uneconomic. (Little-East Central)

5897-B3, C1, C2, E2, F1 POULTRY MANURE A VALU- ABLE FERTILIZER

Departments of Agronomy, Poultry, and
Horticulture, University of Maryland, College
Park, Maryland
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University of Maryland, Cooperative Extension
Service Fact Sheet 39, 1972, 4 p. 1 fig., 5
tab.

Keywords: Poultry wastes, Fertilizers, Nitro-
gen, Phosphate, Potash, Ammonia, Poultry
litter, Land application, Moisture content,

were collected the last five days of a 20-day feeding period. According to the results of Trial 1, 80% of the total nitrogen was recovered in the DPE. The differences among rations in digestibility of nitrogen in percentages of nitrogen intake retained were not significant. The results of Trial 2 showed that the true digestibility of DPE-crude protein is estimated by Smith to be 81% compared with 96% for fresh forages. Mixed dry feeds have been shown to have lower true digestibilities of crude protein than do fresh forages. True digestibility of DPE-crude protein estimated from other digestion trials was in the same range as digestibilities estimated for conventional dry feeds. (Stiles-East Central)

5902-C2, E2 FERTILIZING TRIAL IN A FOREST WITH PIG SLURRY

J.M. Debry
Pedobiologia, V. 19, No. 2, p. 139-152, 1979. 4 fig., 2 tab., 67 ref.

Keywords: Slurries, Land application, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sodium, Iron, Copper, Zinc, Manganese, Sampling, pH, Forests

High level spreadings of pig slurry have been executed on an acid forest floor, in a plantation of the Larch *Larix laricina*. Treatments were conceived as follows: 50 tons/ha (D₁) and 100 t/ha (D₂) by sprinkling; and 450 t/ha (D₃) by close mixing of the organic layer and slurry. A check plot has also been prospected. Nine sampling series have been carried on during the following year in the A₀ and A₁ horizons, to determine the evolution of element content (N, P, K, Ca, Mg, Na, Fe, Cu, Zn, Mn) and a few physico-chemical parameters (organic matter content, C/N ratio, pH). Results are analysed and commented. (Debry) (Article in Foreign Language)

5903-B2, E2 EFFECTS OF COPPER ON THE ALIMENTARY BALANCE OF *ONISCUS ASELLUS* WITH REFERENCE TO COPPER CONTENT IN PIG SLURRY

J.M. Debry and S. Muyango
Pedobiologia, V. 19, No. 2, p. 129-137, 1979. 2 fig., 7 tab., 22 ref.

Keywords: Copper, Swine wastes, Slurries, *Oniscus asellus*, Land application

Within the framework of spreadings of pig slurry on forest floors, we have realised, in the laboratory, a few experiments consisting of additions of slurry to diets of *Oniscus asellus* (Isopoda). The aim was to estimate the effect of such an addition on the alimentary balance. It clearly appears that a treated litter (so, a copper-enriched litter) is more easily assimilated than a reference one. This is corroborated by a greater weight gain for woodlice fed with treated diets. Very interesting comparisons are made between our results and data pointed out in other papers. (Debry) (Article in Foreign Language)

5904-B3; C2, D1, E3 UTILIZATION OF POULTRY EXCRETA AS A SOURCE OF NITROGEN FOR THE GROWING CALVES

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J. Kishan and K.Q. Hussain
Indian Journal of Animal Science, V. 47, No. 12, p. 790-793, Dec., 1977. 4 tab., 9 ref.

Keywords: Poultry wastes-dried, Crude protein, Dry matter, Nitrogen, Calcium, Phosphorus, Refeeding, Performance, Cattle, Digestibility, Dehydration, Diets

A study was conducted for 142 days to determine the extent to which dried poultry excreta could be incorporated into the ration of 15 growing Harijana calves. Animals in group one were given 19% crude protein. In group two and three, the poultry excreta was added to the extent of 15 and 30%, respectively, of the total crude-protein requirement. To meet the dry-matter requirement, wheat *khosee* was given ad lib. to all the calves. The total body weight gains in the group were 70.0, 67.6, and 63.7 kg respectively. Dry-matter intake of animals in groups one, two, and three were, respectively, 2.43 ± 0.11 , 2.16 ± 0.07 and 2.32 ± 0.06 kg/100 kg body weight. In group two and three the digestibility of organic nutrients was not significantly affected by the addition of dried poultry excreta. All three groups of animals were in a state of positive nitrogen balance. In all three groups, calcium and phosphorus balances were positive, but animals in groups two and three retained significantly more calcium and phosphorus. (Little-East Central)

5905-A8, E2 FEEDLOT MANURE SOLVES IRON DEFICIENCY IN GRAIN SORGHUM

Anonymous
Agricultural Engineering Newsletter, V. 5, No. 1, p. 1, Feb., 1979.

Keywords: Feedlot wastes, Iron deficiency, Soils, Recycling, Land application, Crop response

USDA researchers at Bushland, Texas recently found that mixing feedlot manure with a calcareous soil corrected iron (Fe) chlorosis and increased yields of grain sorghum. Grain sorghum growth on Arch fine sandy loam soil was severely reduced by iron deficiency (chlorosis), before manure application, because free calcium carbonate interferes with Fe utilization by the plant. Arch fine sandy loam is a calcareous soil usually found in the Texas High Plains around playa lakes. The following treatments on grain sorghum were compared with Arch soil: (1) Feedlot manure, with and without additional Fe, (2) NPK fertilizer, with and without additional Fe, and (3) Pelleted vs. finely-ground manure. Commercial fertilizer without supplemental iron worsened Fe chlorosis, and decreased yields slightly, while manure increased dry matter yields by 400% of yields from check and NPK treatments. For manure and NPK fertilizer, the best ferrous sulfate treatment was 20 ppm Fe. (Little-East Central)

5906-A2, B1, B2, C1 DESIGN OF VEGETATED FILTER SYSTEMS FOR FEEDLOT &

DAIRY RUNOFF CONTROL

Anonymous
Agricultural Engineering Newsletter, V. 5, No. 2, p. 4-5, April, 1979. 1 fig., 2 tab., 2 ref.

Keywords: Cattle wastes, Feedlot runoff, Overland flow, Channelized flow, Runoff control, Vegetative filters

Grass filter systems should be considered for runoff control where a stream or neighbor's pond is nearby. In Midwestern research two types of grass filter systems were developed: (1) Overland flow (broad, flat grassy area where wastewater can spread over the area), and (2) Channelized flow (grassed terrace or waterway). The design criteria for overland flow systems is: (1) Contact time - 2 hours minimum, (2) Design storm - 1 year, 2 hour rainfall, and (3) Flow width - 20 ft. minimum. Recommended grass filter areas and flow lengths are given. Channelized flow systems require one hour of contact time for each 5000 square feet of feedlot surface. (Little-East Central)

5907-A3, A8, B2, D3, E1, F2 NEW SEEPAGE STANDARDS FOR LAGOONS AND HOLDING PONDS

Anonymous
Agricultural Engineering Newsletter, V. 5, No. 2, p. 2, April, 1979.

Keywords: Legal aspects, Waste treatment, Lagoons, Soils, Runoff control

New requirements were made for the Texas Department of Water Resources (TDWR) for controlling seepage from manure treatment lagoons and runoff holding ponds. The new requirements are: (1) To adequately control seepage of contaminated wastewater into ground waters which are acceptable for use as domestic or livestock water supply, and (2) Wastewater retention facilities will be constructed in clay soils or lined with suitable materials to adequately control seepage of contaminated wastewater into ground waters which are acceptable for use as domestic or livestock water supply. Soil samples will be taken from the holding pond and tested for the following parameters: (1) Percent passing a No. 200 mesh sieve and (2) Atterberg limits. Soil being used as a liner shall be that type which allows more than 30% to pass a No. 200 mesh sieve, liquid limits greater than 30%, and plasticity index greater than 15. The Department shall review all tests. The new requirements should make it easier for livestock and poultry producers to build wastewater treatment and storage lagoons. (Little-East Central)

5908-A6, D2, D3, F1 ODOR CONTROL CHEMICALS FAIL ILLINOIS TESTS

Anonymous
Agricultural Engineering Newsletter, V. 5, No. 1, p. 2, Feb., 1979.

Keywords: Swine wastes, Odor control, Aeration, Chlorination, Economics

Researchers from the University of Illinois tested 22 commercial products for their ability

to control swine manure odor, as per marketing claims. Six other treatments tested were: mechanical aeration, chlorine, waste soil, wintergreen oil, activated charcoal, and U of I experimental product. To evaluate odors in treated and untreated manure samples, odor panels of 40 to 50 people were used. Of the 22 products tested, only Tec II measurably reduced odor strength and offensiveness. A second set of experiments showed that aeration, chlorination, and the U of I experimental product lowered odor strengths and improved odor. With all the chemical treatments, no measurable increase in solids liquification was obtained. Costs ranged from \$0.02 to \$12.40 per year per finishing hog capacity. It was concluded that aeration may still be the most effective odor control method. (Little-East Central)

5909-B1, B4, C3, D3, F1 SLUDGE ACCUMULATION IN ANAEROBIC LAGOONS

Anonymous
Agricultural Engineering Newsletter, V. 4, No. 5, p. 2, Oct., 1978.

Keywords: Anaerobic, Lagoons, Sludge, Poultry wastes, Swine wastes, Cattle wastes, Design, Screening, Economics, Waste storage

Sludge accumulation rates were measured in seven anaerobic lagoons at South Carolina poultry, swine and dairy operations. The average sludge accumulation rates were given. The life expectancy of dairy lagoons was too short (less than 10 years) in all cases examined. The lagoon design values given in the Texas Agricultural Extension Bulletin MP-1341 would yield average life expectancies of 7 yrs. -dairy; 10 yrs. -poultry; and 15 yrs. -swine. One major selling point of lagoon systems has been trouble-free operation with low management input. Fiber separation by screening can also prolong lagoon life for dairies. (Little-East Central)

5910-B2, F1 SUBMERSIBLE PUMP FOR DAIRY MANURE

Anonymous
Agricultural Engineering Newsletter, V. 5, No. 2, p. 3, April, 1979.

Keywords: Cattle wastes, Pumping, Economics, Energy, Equipment-submersible pump

A new submersible, chopper-type manure pump for pumping liquid dairy manure has proven successful in an Extension field demonstration in South Texas. In previous years, clogging problems had occurred. Wastewater volume, pumping rate, energy consumption, and maintenance requirements were measured with the following results: (1) Manure and flush water volume ranged from 89 to 203 gallons per cow per day, averaging 110/cow/day. (2) Pumping rate ranged from 381 to 523 gpm, and averaged 485 gpm at 8.1 ft. vertical lift. (3) Wire-to-water efficiency was 13% at the lowest pumping rate. (4) Maintenance for the first 12 months' operation consisted of (a) removing baling twine wrapped around the pump impeller, (b) dislodging a stuck liquid limit switch, and (c) replacing a gasket under warranty by an

authorized service center. (5) Pumping cost was estimated at \$4.09 per cow per year. (Little-East Central)

5911-A6, B3, D2 VOLATILE AND ODOROUS COMPONENTS IN SOLID SWINE MANURE

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A. Yasuhara and K. Fuwa
Agricultural and Biological Chemistry, V. 43, No. 2, p. 313-316, Feb., 1979. 3 fig., 2 tab., 6 ref.

Keywords: Odors, Swine wastes, Gas chromatography, Fractionation, Phenols, Carboxylic acids

Raw solid swine manure was extracted with dichloromethane. The extracted solution was mixed with distilled water after concentration and steam-distilled. The distillate was extracted with dichloromethane and fractionated into carboxylic acid, phenol, basic, and neutral fractions and all fractions had a characteristic and strong odor. Quantification and characterization of odorous components were performed by GC, GC-MS, NMR, and IR. Ten compounds were detected from the carboxylic acid fraction and three compounds from the phenol fraction. The two main components in the neutral fraction were methyl oxide and diacetone alcohol. (Yasuhara-Japan)

5912-B3, C2, D1 VIBRATING-SCREEN SEPARATION OF DAIRY CATTLE WASTE

North Carolina State University, Raleigh, North Carolina 27607
W.L. Johnson, M.R. Overcash, and J.C. Wilk
American Society of Animal Science, Annual Meeting, July 28-31, 1974, 16 p. 6 fig., 3 tab., 3 ref.

Keywords: Cattle wastes, Equipment-separator, Chemical oxygen demand, Nitrogen, Phosphorus, Potassium, Hemicellulose, Lignin, Cellulose

A 45.7 cm-diameter vibrating screen solids separator was used for pilot studies on physical removal of part of the fecal solids from liquid manure in a dairy waste handling system. The machine used operates with simultaneous vertical and centrifugal vibration. Feces from lactating Jersey cows were diluted 1:15 with water and pumped onto screens of sizes 8, 20, 40 and 60-mesh/2.54 cm. with an input flow rate of 41±7.7 l/min. The percentages of dry matter input removed by the 4 screens were, respectively, 9±4.6, 28±6.0, 35±8.9 and 48±14.0 in 4 trials with each screen. In 3 trials with each screen, the liquid effluent contained 92±7.0, 78±3.0, 71±6.2 and 50±14.6% of the DM input. The effluent from the 4 respective screens contained an average of 96, 93, 89 and 86% of the N input; 88, 88, 84 and 49% as much polluting potential as the manure input, as estimated by COD; 94, 78, 75 and 62% of the P input; and virtually all of the K input. Average *in vitro* DMD (Tilley and Terry) was 32%, with a noticeable decline as size of screen opening

decreased. The average chemical composition of solids removed by all screens (DM basis) was 0.8% Kjeldahl N, 85% NDF, 52% ADF, 39% cellulose, 34% hemicellulose, 12% lignin, 0.6% acid-insoluble ash and 43% crude fiber, the effect of screen size being negligible for these constituents. (Johnson-North Carolina State University)

5913-A9, A10, D3 MOSQUITO CONTROL IN LAGOONS

Anonymous
Agricultural Engineering Newsletter, V. 4, No. 5, p. 2, Oct., 1978.

Keywords: Cattle wastes, Lagoons, Mosquitoes, Insecticides

According to North Carolina State University research, mosquito production in livestock waste lagoons varies inversely with the loading rate. Little or no mosquito production was found in heavily loaded lagoons. The following insecticides provided 95 to 100 percent control of mosquitoes for seven days or more: (1) Chlorpyrifos, (2) Malathion, (3) Abate, (4) Dimilin and (5) Flint. Lagoon digestion performance was not impaired by the use of pesticides at the recommended dosages. (Little-East Central)

5914-A2, A8, C2, E2 WATER QUALITY & SOIL EFFECTS OF FEEDLOT MANURE DISPOSAL

Anonymous
Agricultural Engineering Newsletter, V. 4, No. 5, Oct., 1978.

Keywords: Cattle wastes, Runoff, Chemical oxygen demand, Biochemical oxygen demand, Nitrogen, Soils, Potassium

Runoff quantity and quality from cropland that had received beef feedlot manure at rates of 0 to 205 ton dry matter/acre (0 to 460 mt/ha) was monitored for six years by researchers from Kansas State University. The chemical oxygen demand and biochemical oxygen demand concentrations reflected good bacterial treatment of manure in the soil. The nitrogen concentration was not excessive considering the previous studies. For six years, soil effects of high rate feedlot manure disposal were readily distinguishable on plots receiving more than 25 tons/acre/year of manure dry matter. Potassium accumulations presented some problems in crop production on land receiving manure. (Little-East Central)

5915-A8, E2, F1 TEXAS' CONTROL STRATEGY FOR AGRICULTURAL NONPOINT SOURCES

Anonymous
Agricultural Engineering Newsletter, V. 5, No. 1, p. 3, Feb., 1979. 5 ref.

Keywords: Water quality, Economics, Pollution control, Nonpoint sources

The Texas State Soil and Water Conservation Board published a manual entitled, "State-wide Control Strategy for Agricultural Nonpoint Source Pollution in Texas." The manual represents the state-of-the-art in assessing and reducing water quality problems that originate on agricultural lands. It describes potential water pollution abatement practices which can be applied to Texas. The cost effectiveness, environmental impact, time and management requirements for each water quality management practice are described. The manual will hopefully provide the guidelines for abatement of any type of scientifically proven water quality problem attributed to agricultural nonpoint sources. (Little-East Central)